## **APPENDIX N**

GEOTECHNICAL CONSTRUCTION QUALITY ASSURANCE (CQA) PLAN FOR CONSTRUCTION OF THE LINER SYSTEM

## Prepared for:

Bryan A. Stirrat & Associates 16885 West Bernardo Drive, Suite 305 San Diego, California 92127

## Prepared by:

GeoLogic Associates 16885 West Bernardo Drive, Suite 305 San Diego, California 92127

> May 2003 Revision 1: November 2003 Revision 2: April 2004 9539-65

## **TABLE OF CONTENTS**

<b>SECT</b>	CION	PAGE
1.0	INTR	ODUCTION 1
	1.1	Project Requirements2
2.0	RESI	PONSIBLE PARTIES AND DEFINITIONS 3
	2.1	Responsible Parties
	2.2	Definitions
3.0	GEO	TECHNICAL CQA ORGANIZATION 6
	3.1	Geotechnical Project Director
	3.2	Geotechnical CQA Officer
	3.3	Geotechnical CQA Monitors 8
		3.3.1 Field Engineer/Field Geologist
		3.3.2 Geotechnical CQA Technicians
	3.4	Independent Testing Laboratory
4.0	MEE	TINGS 11
	4.1	Pre-Construction Meetings
	4.2	Weekly Progress Meetings
	4.3	Special Meetings
	4.4	Geosynthetic Material Pre-Installation Meeting12
	4.5	Daily Progress Meetings (if necessary)
	4.6	Manufacturing Plant Visit(s)14
5.0	GEO	TECHNICAL CQA MONITORING FOR EARTH
	MAT	ERIALS
	5.1	General
	5.2	Low Permeability Materials15
	5.3	Demonstration Fill (Test Fill Pad)15
	5.4	Low Permeability Fill Placement
	5.5	Acceptance Criteria17
		5.5.1 General
		5.5.2 Moisture Content and Density

## TABLE OF CONTENTS (CONT'D)

<u>SECT</u>	<u>rion</u>		PAGE
		5.5.3	Permeability
		5.5.4	Lift Thickness and Processing
		5.5.5	Geomembrane Subgrade
6.0	CEO		•
0.0			NICAL CQA MONITORING FOR IETICS19
	6.1		embrane (HDPE) 19
	0.12	6.1.1	HDPE Manufacturing
		6.1.2	Geomembrane Delivery
			6.1.2.1 Transportation and Handling
			6.1.2.2 Geomembrane Storage 21
		6.1.3	HDPE Conformance Testing21
			6.1.3.1 Tests
		•	6.1.3.2 Sampling and Testing Frequency
			6.1.3.3 Sampling Procedures
			6.1.3.4 Test Results
		6.1.4	HDPE Installation23
			6.1.4.1 Earthwork23
			6.1.4.2 HDPE Placement24
			6.1.4.3 Field Seaming
		6.1.5	Construction Testing29
			6.1.5.1 Nondestructive Seam Testing29
			6.1.5.2 Destructive Seam Testing31
			6.1.5.3 Sampling Procedures31
			6.1.5.4 Size of Samples32
			6.1.5.5 Field Testing
			6.1.5.6 Laboratory Testing33

## TABLE OF CONTENTS (CONT'D)

<b>SECTION</b>		<u>PAGE</u>
	6.1.6	Defects and Repairs34
		6.1.6.1 Identification34
		6.1.6.2 Repair Procedures
		6.1.6.3 Seam Test Summary35
	6.1.7	Wrinkles35
	6.1.8	Anchor Trench
	6.1.9	HDPE Acceptance35
	6.1.10	Liner Materials36
6.2	Geosy	onthetic Clay Liner (GCL)
	6.2.1	GCL Delivery37
	6.2.2	GCL Conformance Testing38
		6.2.2.1 Tests
		6.2.2.2 Sampling Procedures
		6.2.2.3 Test Results
	6.2.3	GCL Installation39
		6.2.3.1 Surface Preparation39
	6.2.4	Repairs40
6.3	Geote	xtiles40
	6.3.1	Geotextile Delivery41
	6.3.2	Geotextile Conformance Testing
		6.3.2.1 Tests
		6.3.2.2 Sampling Procedures
		6.3.2.3 Test Results
	6.3.3	Geotextile Installation
		6.3.3.1 Surface Preparation43
		6.3.3.2 Placement
	6.3.4	Repairs44

## TABLE OF CONTENTS (CONT'D)

<b>SECT</b>	<u>ION</u>			<b>PAGE</b>
	6.4	Geoco	mposite	45
		6.4.1	Geocomposite Delivery	45
		6.4.2	Geocomposite Conformance Testing	46
			6.4.2.1 Tests	46
			6.4.2.2 Sampling Procedures	46
			6.4.2.3 Test Results	47
		6.4.3	Geocomposite Installation	47
			6.4.3.1 Surface Preparation	47
			6.4.3.2 Placement	47
		6.4.4	Repairs	48
7.0	DOCI	UMEN'	ΓΑΤΙΟΝ	49
	7.1		Summary Reports	
	7.2	Obser	vation and Test Data Reports	49
	7.3	Const	ruction Corrective Measures Reports	50
	7.4	Design	n and Specification Revisions	50
	7.5	Photo	graphs	50
	7.6	As-Bu	uilt Plans	51
	7.7	Final	Certification Report	51

#### 1.0 INTRODUCTION

A Construction Quality Assurance (CQA) program consists of selected testing, inspection and documentation of a final construction product in order to provide the Owner/Agencies an evaluation of whether the end product is of the specified quality of materials and workmanship. Because of possible conflicts of interest, the Contractor should not undertake the CQA function directly. Rather, CQA inspection and testing should be left under the objective authority of a single team of inspection professionals.

A Construction Quality Control (CQC) program consists of selected tests and inspections performed by the Contractor during production which can assist the Contractor in producing the quality product required. While the CQC function is the sole responsibility of the Contractor, the Project Manager may, at his/her discretion, provide information regarding the ongoing CQA monitoring for the Contractor's use in implementing his/her CQC function. Release of the CQA data to the Contractor is for convenience only and, in no way, relieves the Contractor from their responsibility to fulfill the project requirements.

The composite liner system proposed for the GCLF consists of individual discrete layers of earth and synthetic materials which will function as a unit to form the containment system for the waste management area. A geocomposite drainage layer and additional layers of GCL and geomembrane will also be installed on benches and under the LCRS mainline as shown on the Project Drawings.

Each of these components functions as an integral part of the composite liner system and consequently must become a finished product during the course of construction. As a result, it is important that each layer or component of the composite liner be completed to the design specifications prior to construction of successive or overlying layers. For this reason, it is both inefficient and impractical to withhold CQA testing until completion of the liner and it is necessary to conduct an ongoing CQA program during construction.

This document presents the geotechnical Construction Quality Assurance (CQA) Plan for installation of the earthwork and geosynthetic components of the composite liner system for the Gregory Canyon Landfill (GCLF) in San Diego County, California. This CQA Plan is to be used in conjunction with the Preliminary Engineering Design and Phased Development Plans (September 2001) and Specifications prepared for the GCLF.

#### This plan includes:

• A Quality Assurance Program to be implemented during earthwork and geosynthetic material construction; including field observation, laboratory and field testing, and acceptance criteria for constructed work;

- Recording and documentation procedures to be employed for demonstrating that the
  constructed earthwork and geosynthetic liner components meet the requirements of
  the Project Plans and Specifications;
- Lines of communication, responsibilities and roles of the Construction Quality Assurance team and other related Project Personnel.

#### 1.1 PROJECT REQUIREMENTS

In order to satisfy the requirements established by the governing regulatory agencies, the following composite liner system design has been proposed for the GCLF.

In floor areas (gradient less than 5:1 horizontal:vertical), the composite liner system designs will be composed of the following elements:

- Subgrade prepared to the requirements of the Project Documents;
- A one-foot thick subdrain gravel layer composed of select drainage gravel materials;
- A twelve (12)-ounce per square yard non-woven geotextile fabric;
- A minimum two (2) foot thick compacted soil liner yielding a permeability of less than 1.0 x 10<sup>-7</sup> cm/sec;
- A 60-mil thick double-sided textured HDPE geomembrane;
- A sixteen (16) ounce per square yard non-woven geotextile fabric:
- A nine-inch minimum thickness gravel or equivalent drainage layer;
- A sixteen (16) ounce per square yard non-woven geotextile fabric:
- A 60-mil thick double-sided textured HDPE geomembrane;
- A geosynthetic clay liner (GCL):
- An 80-mil thick double-sided textured HDPE geomembrane;
- A sixteen (16) ounce per square yard non-woven geotextile fabric;
- A one (1) foot thick leachate collection layer composed of select drainage gravel materials;
- A twelve (12) ounce per square yard non-woven geotextile fabric;
- A two (2) foot thick protective cover soil layer (operations layer) composed of select on-site soil materials. Said materials shall be screened to exclude particles in excess of one-inch in maximum dimension.

In slope areas (gradient steeper than 5:1 horizontal:vertical) the liner system will be composed of the following elements:

- Subgrade prepared to the requirements of the Project Documents;
- A minimum two (2) foot thick compacted soil liner yielding a permeability of less than  $1.0 \times 10^{-7}$  cm/sec:
- A 60-mil thick double-sided textured HDPE geomembrane;
- A geosynthetic clay liner (GCL);
- An 80-mil thick single-sided textured HDPE geomembrane (textured side placed down);
- A sixteen (16) ounce per square yard non-woven geotextile placed immediately on top of the geomembrane;
- A minimum two (2) foot thick protective soil cover (operations layer) composed of select on-site soil materials. Said materials shall be screened to exclude particles in excess of one-inch in maximum dimension.

All materials used to construct the composite liner system must meet or exceed the criteria established in this CQA document and the Project Plans and Specifications. Any deviation from these criteria must be pre-approved by the Engineer and the Geotechnical CQA Consultant.

#### 2.0 RESPONSIBLE PARTIES AND DEFINITIONS

#### 2.1 **RESPONSIBLE PARTIES**

The responsible parties for all composite liner system construction activities at the GCLF, as set forth herein, are as follows:

#### Owner:

Gregory Canyon Ltd.

3 Embarcadero Center, Suite 2360

San Francisco, California 94111

Phone:

(415) 391-2833

Contact: General Manager, Dr. Jerry Riessen

#### Landfill Operator:

Gregory Canyon Ltd.

3 Embarcadero Center, Suite 2360

San Francisco, California 94111

Phone:

(415) 391-2833

Contact:

General Manager, Dr. Jerry Riessen

#### Landfill Engineer:

Bryan A. Stirrat & Associates 1360 Valley Vista Drive Diamond Bar, California 91765 Phone: (909) 860-7777

Contact: Mr. Mike Cullinane

#### Construction Manager:

To Be Determined

#### Geotechnical CQA Consultant:

To Be Determined

#### 2.2 **DEFINITIONS**

"Construction Manager" - Person(s) or firm(s) authorized by the Owner to manage and oversee the administration of the Construction Contract. The Construction Manager shall be responsible for evaluating lines and grades (survey control) for the individual liner elements as well as verification of payment request, submittal acceptance, and change orders.

"Contractor" - The firm responsible for all elements of construction of the containment system. In this regard, the Contractor's responsibilities includes but are not limited to: preparation of subgrade and supporting surfaces (generally soil) for the geosynthetic installation; installation of the HDPE and geosynthetics; and placing earth and granular materials over the installed synthetic systems. The Contractor is further responsible for all activities of Subcontractors including but not limited to the geosynthetics Subcontractor.

"Geosynthetics" - A generic classification given to synthetic (man-made plastic and fabric) materials used in geotechnical and construction applications. Included are geomembrane or flexible membrane liners (i.e., HDPEs), geotextiles, geosynthetic clay liner (GCL), geonets, geogrids, geocomposites and geocells. At the GCLF, the term geosynthetics is used to refer to the HDPE, GCL, geocomposites and geotextiles.

"Geosynthetic Subcontractor" - The firm responsible for handling, storing, placing, seaming, and other aspects of the installation of the geosynthetics included in the composite liner system.

"Geotechnical CQA Officer" - The individual or firm serving under the direction of the Geotechnical Project Director and responsible for day to day geotechnical Construction Quality Assurance (CQA).

"Geotechnical CQA Monitors" - The individuals working under the direction of the Geotechnical CQA Officer who are routinely involved in the construction process. Such personnel include "Technicians", "Field Engineers" and "Field Geologists" representing the Geotechnical Consultant. CQA Monitors responsible for the geosynthetics and earthwork, shall be experienced in landfill construction monitoring, geosynthetic material installation, low-permeability soil construction and testing, and compaction testing during grading operations.

"Geotechnical Consultant" - Geotechnical firm responsible for the design and specifications for the earthwork and geosynthetic elements of the Project Plans and Specifications. The Geotechnical Consultant or his/her representative is also responsible for observing, testing, and documenting activities related to quality assurance for all geotechnical and geosynthetic aspects of construction except for engineering and survey control. All completed geotechnical work is subject to approval by the Geotechnical Consultant.

"Geotechnical Project Director" - Geological/geotechnical professional registered in the State of California who, under the employ of the Geotechnical Consultant is responsible for earthwork observation, monitoring and testing.

"Geotechnical Construction Quality Assurance for Earthwork" - The protocols to be followed in evaluating the adequacy of the Contractor's work with regard to all elements of earthworks construction with the exception of line and grade (survey) control. Said work shall include but need not be limited to all CQA activities delineated herein and in the Specifications. Geotechnical CQA is to be provided by a party independent of the Contractor.

<u>"Geotextile"</u> - A permeable synthetic fabric used with soil, rock, sand, gravel or any other similar materials as an integral part of the composite liner system. It can provide protection to other systems or serve to separate different materials.

"Independent Testing Laboratory" - The firm responsible for conducting selected tests of materials and/or products used for the project, such as conformance testing. The laboratory shall be independent of the Manufacturer, Contractor, Geosynthetics Subcontractor and any party involved with the manufacture and/or installation of any product to be tested.

"Landfill Engineer" - The firm responsible for the design and preparation of the Project Plans and Specifications including the containment system that fulfills the regulatory and operational requirements of the permitting agencies and Owner,

respectively. The Landfill Engineer, also known as the Engineer, is also responsible to modify or change the design if unexpected or unanticipated site conditions are encountered during construction.

<u>"Project Documents"</u> - Project Documents include all Construction Drawings, Record Drawings, Construction Specifications, CQA Plans, Health and Safety Plans and Project Schedules and Contractor Submittals.

<u>"Project Manager"</u> - The Owner's designated representative responsible for the Project.

<u>"Project Drawings and Specifications"</u> - All project related Drawings and Specifications including Design Modifications and Record Drawings.

<u>"Quality Assurance"</u> - Actions taken by the Owner or his representative necessary to evaluate whether the earthen and geosynthetic materials and workmanship meet the requirements of the Project Plans and Specifications.

"Quality Control" - Actions taken by the Contractor, Subcontractors and/or Liner Manufacturer(s) to ensure that the earthen and geosynthetic materials and workmanship meet the requirements of the Project Plans and Specifications.

"Work" - All tools, equipment, supervision, labor, and materials or supplies necessary to complete the project as specified herein and as shown on the Project Drawings.

### 3.0 GEOTECHNICAL CQA ORGANIZATION

The Geotechnical CQA Team for composite liner system construction will be composed of design and field personnel with specific experience in the inspection and Geotechnical CQA monitoring of earthwork, low-permeability liner soils and geosynthetic materials specifically related to landfill liner construction. The principal categories of personnel assigned to the Geotechnical CQA Team are presented below.

#### 3.1 GEOTECHNICAL PROJECT DIRECTOR

The Geotechnical Project Director shall be a representative of the Geotechnical CQA Consultant and shall have overall responsibility for all geotechnical CQA activities and have specific experience in managing landfill liner construction projects.

The Geotechnical Project Director will be responsible for reviewing all earthwork or geosynthetic issues which may arise during construction. The Geotechnical Project Director's approval will be required for any earth or geosynthetic material modifications or for any design modifications which may impact the performance of the earth or geosynthetic materials.

#### 3.2 GEOTECHNICAL CQA OFFICER

The Geotechnical CQA Officer will serve as the Geotechnical Project Director's on-site representative. All Geotechnical CQA functions will be his/her direct responsibility. All coordination, reporting and issues related to earthwork and/or geosynthetics non-compliance will be directed through the CQA Officer. In addition, he/she will participate with the Landfill Engineer and Geotechnical Project Director in all decisions related to design issues which arise during the course of construction.

The Geotechnical CQA Officer shall be responsible for overall review, observation, sampling, and testing of activities utilized for Construction Quality Assurance (CQA). The Geotechnical CQA Officer shall have prior experience serving as the CQA Officer on similar liner construction projects. Specific duties of the CQA Officer include:

- Review of all designs, Project Plans, and Specifications;
- Implementation of the Geotechnical CQA program including: assignment and management of all Geotechnical CQA personnel; review of all field reports; and review of all Geotechnical CQA related issues;
- Review of design changes and coordination of such changes with the Engineer;
- Serving as the on-site representative of the Geotechnical Project Director;
- Familiarization of all Geotechnical CQA Monitors with the site and the Geotechnical CQA requirements of the project;
- Attendance at Geotechnical CQA related meetings (i.e., preconstruction, progress, and special meetings as required);
- Review of all Liner Manufacturer and Liner Subcontractor certifications and documentation and development of appropriate recommendations;
- Designation of a senior Geotechnical CQA Monitor to act on his/her behalf at the site while he/she is absent and operations are ongoing;
- Notation of any on-site activities that could result in damage to the geosynthetics;

- Review of the Liner Subcontractor's personnel qualifications for conformance with project requirements;
- Selection of locations for destructive test sampling;
- Oversight of the ongoing preparation of "As-Built" Plan(s);
- Review of all Geotechnical CQA Monitors daily reports and logs;
- Reporting to the Construction Manager and logging in his/her daily report any relevant observations reported to him by the Geotechnical CQA Monitors;
- Oversight of the marking, packaging and shipping of all laboratory test samples;
- Review of the results of laboratory testing and presentation of appropriate recommendations;
- Preparation of a monthly summary of Geotechnical CQA activities;
- Reporting of any unresolved deviations from the Geotechnical CQA Plan to the Construction Manager;
- Preparation of the final "As-Built" report for all completed geosynthetic construction activities:

#### 3.3 GEOTECHNICAL CQA MONITORS

#### 3.3.1 FIELD ENGINEER/FIELD GEOLOGIST

The Field Engineer/Field Geologist will be a representative of the Geotechnical CQA Consultant and will be responsible for evaluating whether earth and/or synthetic materials conform to the requirements of the Project Drawings and Specifications. The Field Engineer/Field Geologist will have specific experience in landfill construction monitoring, compaction observation and testing during grading operations, and geosynthetic material observation, monitoring and documentation. Duties of the Field Engineer/Field Geologist will include the following:

- Subgrade inspection, review, testing and documentation.
- Review of the adequacy of all clearing, grubbing, stripping and preparation of areas to receive fill.
- Monitoring and evaluation of any soil blending, mixing and processing operations.

- Evaluation of the engineering characteristics of the processed and constructed earth materials.
- Observation and evaluation of all cuts which may be impacted by geologic conditions.

#### 3.3.2 GEOTECHNICAL CQA TECHNICIANS

Geotechnical CQA Technicians will be representatives of the Geotechnical CQA Consultant and will continuously observe all grading and geosynthetic operations to provide a basis for concluding that construction is carried out in conformance with the Project Drawings and Specifications. The duties of the Geotechnical CQA Technicians include monitoring, observing and testing all earthwork as well as monitoring, logging and documenting all geosynthetic installation operations.

The operations to be monitored observed and/or tested for the earthwork include:

- Observation of subgrade surface preparation.
- Verification that liner soils are derived from appropriate sources.
- Visual evaluation of the soil physical properties for consistency with the Project Drawings and Specifications.
- Evaluation of all moisture conditioning and processing operations to evaluate uniformity of material and moisture content.
- Evaluation of the constructed low-permeability liner material for conformance with the Project Drawings and Specifications.
- Identification of deleterious materials or other deficiencies in soil characteristics to minimize the possibility that these materials are incorporated into the composite liner system.
- Monitoring of activities for the removal and/or disaggregation of oversize material.
- Observation of uniformity of coverage of compaction equipment, especially at fill edges, turnaround areas and on slope faces.
- Monitoring of lift thickness.
- Observation of the active fill pad at the beginning of each grading day and establishment of requirements for wetting/drying and/or processing of exposed surfaces prior to placement of additional fill.

- Undertaking field tests including but not limited to BAT permeability and field moisture/density testing at the minimum frequencies noted herein or at any time that a deficiency is suspected.
- Recovery of samples for laboratory testing.
- Completion, evaluation and/or documentation of laboratory testing of the permeability, grain size distribution, Atterberg Limits, in-place moisture content and density of the low-permeability layer materials in accordance with the requirements of the Specifications (including retests, if necessary).
- Confirmation that the test results are in accordance with the Project Specifications (including retests of any previously failed areas).

The operations to be observed and monitored for all geosynthetics include:

- Material delivery.
- Unloading and on-site transport and storage.
- Placement/deployment operations.
- Joining and/or seaming operations.
- Repair operations.

Specifically, the seaming operations to be monitored include:

- The condition of panels as placed.
- Trial seams.
- Seam preparation.
- Seaming.
- Nondestructive seam testing.
- Sampling for destructive seam testing.
- Laboratory test sample marking.
- Repair operations.
- Reviewing the final certification of seams.

All observations shall be reported in a timely manner to the CQA Officer and the Construction Manager.

#### 3.4 INDEPENDENT TESTING LABORATORY

The Independent Testing Laboratory shall be certified by the Geosynthetic Accreditation Institute (GAI) in the specific tests to be performed and will perform all conformance testing of geosynthetics and all destructive laboratory testing of field seams.

#### 4.0 MEETINGS

In order to facilitate construction of the composite liner system, close coordination between the Construction Manager, Engineer, Geotechnical CQA Consultant, Contractor, Liner Subcontractor and Geotechnical CQA personnel is essential. To this end the following meetings will be scheduled.

#### 4.1 PRE-CONSTRUCTION MEETINGS

A Pre-construction Meeting will be held at the site. At a minimum, the meeting shall be attended by the Owner (or designated representative), the Construction Manager, the Landfill Engineer, the Geotechnical Consultant (or designated representative), the Contractor and appropriate Geotechnical CQA staff. Specific items to be considered at this meeting will include:

- Any appropriate modifications to the Geotechnical CQA requirements.
- Development of a format for site specific documentation.
- Review of the responsibilities of each party.
- Review of the lines of authority and communication.
- Review of work area security and safety protocol.
- Review of the procedures for project documentation and reporting, and distribution of documents and reports.
- Review of procedures for submittals, change orders and extra work efforts.
- Review of the Contractor's proposed methods of construction, (including equipment), with specific emphasis on methods of select grading, soil mixing, stockpiling, processing, moisture conditioning and compaction.
- Review of the procedures for field and laboratory CQA testing.
- Establishment of procedures for correcting and documenting construction deficiencies.
- Conducting an initial site inspection to discuss work areas, stockpile areas, mixing tables, laydown areas, access roads, haul roads, and related items.
- Review of the project schedule.

The meeting shall be documented by the Construction Manager and minutes shall be distributed to all parties.

#### 4.2 WEEKLY PROGRESS MEETINGS

Progress Meetings shall be held weekly. At a minimum, these meetings shall be attended by the Owner (or designated representative), the Construction Manager, the Geotechnical CQA Officer and/or the Geotechnical CQA Monitors, and the Contractor. Weekly progress meetings shall be documented by the Construction Manager or his/her representative and minutes shall be distributed to all parties. The purpose of these meetings is to:

- Discuss any health and safety related issues.
- Review scheduled work activities.
- Discuss project related problems.
- Review laboratory and field test data.
- Discuss the Contractor's personnel and equipment assignments.
- Review the previous week's activities and accomplishments.

#### 4.3 SPECIAL MEETINGS

Special meetings will be conducted as required to discuss any problems or deficiencies. At a minimum, these meetings will be attended by the Owner (or designated representative), Construction Manager, appropriate Geotechnical CQA staff and the Contractor. If correction of a problem requires a design modification, the Landfill Engineer and the Geotechnical Project Director will also be present. The purpose of these meetings is to:

- Define and discuss any problems or deficiencies in the Project.
- Review possible corrective actions or solutions.
- Implement an action plan to resolve the problems or deficiencies.

Special meetings shall be documented by the Construction Manager or his/her representative and minutes shall be distributed to all parties.

#### 4.4 GEOSYNTHETIC MATERIAL PRE-INSTALLATION MEETING

A Geosynthetic Material Pre-installation Meeting shall be held at the site before installation of the geosynthetics. At a minimum, the meeting shall be attended by the Construction Manager, the Engineer, the Contractor, the Liner Subcontractor, and Geotechnical CQA staff. The Pre-Installation Meeting will not be conducted until all Manufacturer Certifications required by the Project Specifications and this document are received, reviewed and approved.

Specific items to be addressed at this meeting include:

- Submittal and review of relevant documents.
- Definition of appropriate modifications to the Geosynthetic Geotechnical CQA requirements.
- Development of a format for site specific documentation.
- Definition of the responsibilities of each party.
- Definition of lines of authority and communication.
- Review of work area security and safety protocol.
- Definition of methods for documenting and reporting, including distributions.
- Selection of welding equipment and procedures.
- A field welded seam(s) demonstration.
- Identification of testing equipment and procedures, including peel and shear tests, and procedures for communicating laboratory test results.
- Identification of procedures for correcting and documenting construction deficiencies.
- A site inspection to discuss storage areas, work areas, storage areas and protocols, laydown areas, access roads, haul roads, and related items.
- Review of the project schedule.

The meeting shall be documented by the Construction Manager and minutes shall be distributed to all parties.

### 4.5 DAILY PROGRESS MEETINGS (if necessary)

Daily Progress Meeting shall be held in the field before the start of work each day. At a minimum, this meeting shall be attended by the Geotechnical CQA Officer or his/her representative, Geotechnical CQA Monitors, the Contractor and the Liner Subcontractor. The purpose of this meeting is to:

- Review and coordinate scheduled work activities between the Geotechnical CQA monitors and the Liner Subcontractor's crew.
- Discuss any problems.
- Review test data.

- Discuss the Liner Subcontractor's personnel and equipment assignments for the day.
- Review the previous day's activities, accomplishments and/or deficiencies.

## 4.6 MANUFACTURING PLANT VISIT(S)

The Liner Subcontractor shall make arrangements with the Liner Manufacturer(s) to allow the Geotechnical CQA Officer or his/her designee to visit the geosynthetics manufacturing plant(s) during manufacture of the liner material for this project and to observe manufacturing methods and quality control of manufactured materials. If appropriate, the Geotechnical CQA Officer or his/her designee shall review the manufacturing process, quality control, laboratory facilities and testing procedures.

During the plant visit, those visiting shall:

- Observe that the geosynthetic properties presented in the Liner Manufacturer's certification documents meet the Project Specifications.
- Verify that the measurements of properties by the Liner Manufacturer are properly documented and test methods used are acceptable.
- Spot inspect some of the geomembrane rolls and verify that they are free of holes, blisters, or any sign of contamination by foreign matter.
- Review packaging and transportation procedures to verify that these procedures are not damaging the geosynthetics.
- Observe that roll packages have a label indicating the name of the Liner Manufacturer, type of geosynthetic, its roll/panel number and other required information.
- Verify that extrusion rods and/or beads are derived from the same base resin type as the geomembrane.

# 5.0 GEOTECHNICAL CQA MONITORING FOR EARTH MATERIALS

#### 5.1 GENERAL

Construction of the earth materials portion of the composite liner system shall be performed in accordance with the Project Drawings and Specifications and shall be continuously observed, and routinely sampled and tested by the Geotechnical CQA Monitors for the physical parameters described in this section.

The testing frequency presented herein is a minimum. Additional tests will be conducted by the Geotechnical CQA Monitor for retests and at any time that in the opinion of the Geotechnical CQA Monitor, additional testing is required and/or a deficiency is suspected. Retests of previously failed areas will be performed at the discretion of the Geotechnical CQA Monitor when, in his/her opinion, sufficient reworking of the area has been performed to warrant a retest.

#### 5.2 LOW-PERMEABILITY MATERIALS

The low-permeability layer of the composite liner system will be constructed with on-site or import soils derived from a source approved by the Geotechnical Consultant. Low-permeability liner materials will be evaluated by the Geotechnical Consultant according to the following minimum testing schedule in order to characterize material properties:

**Low-Permeability Import Material Testing Type and Frequency** 

<b>Test Description</b>	Test Designation	Minimum Test Frequency	
Particle Size Analysis	ASTM D422	One per 2000 yds <sup>3</sup> stockpiled or one per production day (minimum)	
Atterberg Limits	ASTM D4318	One per 2000 yds <sup>3</sup> stockpiled or one per production day (minimum)	
Classification of Soils for Engineering Purposes	ASTM D2487	One per 2000 yds <sup>3</sup> stockpiled or one per production day (minimum)	
Processed Moisture Content (following moisture conditioning)	ASTM D4643 (microwave) or ASTM D2216 (oven)	Two per construction day	
Laboratory Permeability	ASTM D5084/EPA 9100 or USBR Modified E-13	One per 10,000 c.y	
Moisture/Density Relationship	ASTM D1557	One per 10,000 c.y.	
Visual Inspection	ASTM D2488	Daily while stockpiling	

No soils other than those obtained from the approved borrow source and/or approved by the Geotechnical Consultant are to be used in liner construction.

#### 5.3 DEMONSTRATION FILL (TEST FILL PAD)

A Demonstration Fill (Test Fill Pad) will be constructed prior to actual liner construction to evaluate both the low-permeability soil proposed for liner construction and the Contractor's equipment and methods for constructing and maintaining the integrity of the low-permeability liner soils. The Demonstration Fill will be constructed by the Contractor selected to complete liner construction and as specified in the Project Specifications. Construction of the Demonstration Fill shall be completed a minimum of two weeks prior to the actual low-permeability liner construction. The Contractor shall construct the Demonstration Fill using the same earthwork equipment and Specifications to be used for liner construction to determine if the specified density/moisture content/hydraulic conductivity relationships determined in the laboratory can be achieved in the field with the compaction equipment to be used and at the specified lift thickness.

Soil sampling will be performed by the Geotechnical CQA Monitor(s) during and after construction of the Demonstration Fill to provide data regarding soil properties obtainable using the proposed design and construction methods. All criteria for Demonstration Fill construction, including low-permeability material processing, amount of compaction, moisture content, etc., will be the same as those required and anticipated for actual liner construction.

The purpose of the Demonstration Fill is to: 1) evaluate the performance of the construction equipment to be used for soil blending, processing, placement and maintaining the low-permeability soils under actual construction conditions; 2) evaluate the field performance of the low-permeability soil material through laboratory and field tests; 3) compare field (BAT) and laboratory permeability test results; and 4) develop a database of test results and performance standards prior to full-scale liner construction in order to substantiate the Construction Specifications. If necessary, the results from the Demonstration Fill construction and testing program will be used to modify the Project Specifications for low-permeability liner construction.

The Demonstration Fill will measure roughly 150 feet by 50 feet and will consist of an approximately 24-inch thick section of blended, processed, cured and compacted low-permeability soils, placed on slope and floor areas. The Demonstration Fill shall be constructed using the methods, materials and equipment to be employed during construction of the actual low-permeability layer. Processed low-permeability materials will be placed in six to eight inch lifts. Construction will be continuously observed and tested by the Geotechnical CQA Monitor and/or his/her representative.

The testing frequency used in construction and monitoring of the Demonstration Fill will be more stringent than that to be maintained during construction of the actual liner. Minimum testing requirements for Demonstration Fill construction will include:

- 1. Full-Time observation.
- 2. Density tests (ASTM D1556, D2937, or D2922) taken at a rate of at least one (1) test per 100 cubic yards of fill placed or one (1) per 6 inches of fill thickness. At a minimum, ten (10) in-place moisture/density tests will be completed.
- 3. At least two (2) maximum density tests (ASTM D1557) will be completed.
- 4. Five (5) in-situ BAT permeability tests will be conducted.
- 5. Five (5) laboratory permeability tests on relatively undisturbed samples (Modified USBR E-13 or ASTM D5084) will be conducted including at least one triaxial cell permeability test (ASTM D5084).
- 6. Five (5) Atterberg Limit tests (ASTM D4318) and five (5) grain size analyses (ASTM D422) will be completed.

#### 5.4 LOW-PERMEABILITY FILL PLACEMENT

Select low-permeability liner soils shall be screened (if necessary), dried, and/or moisture conditioned until uniformly blended material characteristics and moisture condition are attained. Moisture conditioning, if required will allow for a minimum 48-hour curing period. Field and laboratory testing for moisture content, in-place dry density, and other engineering properties including saturated hydraulic conductivity during construction of the low-permeability layer of the liner system will be completed according to the following minimum schedule:

Low-Permeability Fill Testing Type and Frequency

20W-1 Clinicability Fill Testing Type and Frequency				
Test Description	Test Designation	Minimum Test Frequency		
Processed Moisture Content (following moisture conditioning)	ASTM D4643 (microwave) or ASTM D2216 (oven)	Two per construction day		
Moisture-Density Relationship	ASTM D1557	One per 5,000 cubic yards or per change in material type		
In-Place Moisture-Density (Nuclear and/or Drive Ring)	ASTM D2922 ASTM D3017 ASTM D2937	One per 250 cubic yards placed		
In-Place Density and Moisture Content (Sand-Cone)	ASTM D1556	One per 1,000 cubic yards placed or 20 percent of total In-Place tests (whichever is greater)		
Particle Size Analysis	ASTM D422	One per 5,000 yd <sup>3</sup> (conducted on samples retrieved for laboratory permeability testing)		
Atterberg Limits	ASTM D4318	One per 5,000 yd <sup>3</sup> (conducted on samples retrieved for laboratory permeability testing)		
Laboratory Permeability	ASTM D5084/EPA 9100 or USBR Modified E-13	One per 5,000 cubic yards placed		
BAT Permeability		One per 2,500 cubic yards placed		
Visual Inspection	ASTM D2488	Daily		

#### 5.5 ACCEPTANCE CRITERIA

#### 5.5.1 GENERAL

Where test results indicate that the lift thickness, maximum particle size, homogeneity of material, cure time, moisture content, density, or permeability of any portion of the work is below the project requirements, that particular portion shall be retested and/or reworked or replaced until the required condition has been attained and the resulting product meets or exceeds the requirements of the Project Specifications. No additional fill shall be placed over an area until the existing fill has been tested horizontally and vertically and determined by the Geotechnical CQA Monitor to meet the Project Earthwork Specifications. The area to be reworked will be verified by survey if in the opinion of the Geotechnical CQA Monitor conditions warrant.

#### 5.5.2 MOISTURE CONTENT AND DENSITY

If in the opinion of the Geotechnical CQA Officer or the Senior Geotechnical CQA Technician, low-permeability materials which have been placed and/or are

ready to be placed, do not visually have a uniform and homogeneous moisture content throughout the material in question, these materials will be removed, without testing, and will be reprocessed and/or reworked until, in the opinion of the Geotechnical CQA Officer or his/her designated representative, they are uniform in appearance.

For all fill materials placed, if test results indicate a relative dry density of less than that required or a moisture content outside the limits specified, then the area will be considered inadequate and will be reworked. Any reworked areas will be retested by the Geotechnical CQA Monitor to verify the reworked area meets the density and moisture content requirements.

The following table lists the minimum moisture/density requirements for fill materials placed. The in-place moisture content and dry density requirements are relative to the maximum dry density and optimum moisture content as determined by ASTM D1557.

Fill Type	Minimum Density (percent)	Moisture Content
Low-Permeability Layer Material	90	2 – 4% above optimum
Unclassified Fill	90	Optimum to 2% above
Protective Cover Soil	85	Optimum ± 2%

#### 5.5.3 PERMEABILITY

If a BAT or laboratory permeability test results in a value exceeding the defined maximum of 1.0 E-07 cm/sec, two (2) additional tests of the same type will be taken in the immediate vicinity. [At the discretion of the Geotechnical CQA Consultant, BAT permeability tests may be taken in lieu of failed laboratory tests to expedite the CQA testing procedure.] If either of the additional tests fails to meet the minimum requirements, the area represented by the test will be considered inadequate and will be removed or reprocessed and recompacted.

#### 5.5.4 LIFT THICKNESS AND PROCESSING

If at any time the CQA Monitor observes an uncompacted lift thickness in excess of eight inches or observes material being placed without meeting the requirements for processing, stockpiling and curing, the Contractor shall immediately discontinue placing additional fills in that area. For an over thick lift, the Contractor shall immediately blade the surface to reduce the lift thickness to the Project Specifications prior to compaction. If inadequately mixed materials are placed, the Contractor shall immediately remove these materials and return them to the stockpile/processing area where they will be reprocessed.

#### 5.5.5 GEOMEMBRANE SUBGRADE

The CQA Monitor and the geomembrane installation Contractor will observe and approve the geomembrane subgrade prior to geosynthetic material deployment. The finish surface shall be free of abrupt breaks, sharp objects, or other foreign material which may damage the overlying geomembrane. The subgrade shall be unyielding, smooth and uniform and the surface shall not be pebbly or tracked and rutted by equipment.

Immediately prior to geomembrane deployment, all subgrade surfaces (i.e., floor and slopes), will be proof-rolled with a steel drum roller weighting not less than 200 pounds per lineal inch of drum width.

Geomembrane deployment shall not proceed until the surface has been approved by the CQA Monitor and accepted by the geomembrane installation Contractor.

# 6.0 GEOTECHNICAL CQA MONITORING FOR GEOSYNTHETICS

#### 6.1 GEOMEMBRANE (HDPE)

Delivery of geomembrane to the site will not be allowed until all required documentation and/or certifications are approved by the CM/Geotechnical CQA Team. It is the responsibility of the Contractor/Subcontractor to ensure that all required documentation and/or certifications are approved prior to shipment.

#### 6.1.1 HDPE MANUFACTURING

Prior to the delivery of any geosynthetic material, the Liner Manufacturer shall provide the Construction Manager with the following:

- A properties sheet for the rolls to be delivered including all specified properties measured using test methods indicated in the specifications.
- The sampling procedure and results of testing.
- A certification for each roll stating that property values given in the properties sheet are guaranteed by the Liner Manufacturer.

The Geotechnical CQA Officer shall verify that:

- The property values certified by the Liner Manufacturer meet the project specifications.
- The measurements of properties by the Liner Manufacturer are properly documented and that the test methods used are acceptable.

Prior to shipment, the Liner Manufacturer shall provide the Construction Manager with a quality control certificate for each roll of geomembrane. The quality control certificate(s) shall be signed by a responsible person employed by the Liner Manufacturer and shall include:

- Lot and roll numbers and identification.
- Sampling procedures and results of quality control tests. At a minimum, results shall be given for those properties identified in the Project Specifications.

The Geotechnical CQA Officer shall:

- Verify that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls related to it.
- Review the quality control certificates and verify that the certified roll properties meet the specifications.

#### 6.1.2 GEOMEMBRANE DELIVERY

Prior to delivery, all individual roll manufacturer certifications required by this document and/or the Project Specifications must be received and approved by the Construction Manager. Delivery of any unapproved roll will not be allowed and unapproved rolls will be transported off-site at the Contractors expense.

#### 6.1.2.1 Transportation and Handling

All transportation and on-site handling of the geomembrane is the responsibility of the Contractor and Liner Subcontractor.

The Geotechnical CQA Officer shall observe the handling equipment used on the site and provide comment on whether it might pose a risk of damage to the geomembrane. The Geotechnical CQA Officer will also observe the Contractor and Liner Subcontractor personnel's handling of the geomembrane and provide comment on whether appropriate care is being taken. Finally, the Geotechnical CQA monitor shall verify that all documentation required upon delivery has been received.

Upon delivery at the site, the Contractor, Liner Subcontractor and the Geotechnical CQA Monitor shall complete a surface observation of all rolls for defects and damage. This inspection shall be conducted without unrolling rolls unless defects or damage are found or suspected. The Geotechnical CQA Officer shall report the following to the Construction Manager:

- Rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws.
- Rolls which visually include minor repairable flaws.

Any damaged rolls shall be rejected and removed from the site or be stored at a location separate from accepted rolls as designated by the Construction Manager. All rolls which do not have proper Liner Manufacturer's documentation shall be removed from the site at the Contractors expense until all required documentation has been received and approved.

A log of all HDPE received shall be maintained by the Geotechnical CQA Monitors and recorded on an appropriate form (Form B-1 attached).

#### 6.1.2.2 Geomembrane Storage

The Contractor and Liner Subcontractor shall be responsible for storage of the HDPE on-site and shall ensure the storage is consistent with the Manufacturer's recommendations. The Contractor shall coordinate with the Construction Manager to ensure that storage space is provided in a location (or several locations) such that on-site transportation and handling are minimized. Storage space shall be protected by the Contractor and Liner Subcontractor from theft, vandalism, and damage from actions of man, weather, animals and other sources. The Geotechnical CQA Monitors shall observe that the materials are not stored directly on the ground and storage of the HDPE is completed in a fashion that protects against damage.

#### 6.1.3 HDPE CONFORMANCE TESTING

#### 6.1.3.1 Tests

Upon delivery of the HDPE, the Contractor or Liner Subcontractor shall ensure that conformance samples are obtained and forwarded to the Independent Testing Laboratory at the frequency required for testing to ensure conformance with the Project Specifications. All conformance samples will be obtained in the presence of the Geotechnical CQA Monitor or his/her designated representative.

At a minimum, conformance tests will include determination of the following characteristics for the HDPE:

- Density (ASTM D1505A).
- Environmental Stress Crack (ASTM D5397).
- Tear Resistance (ASTM D1004 Die C).

- Carbon black content (ASTM D1603).
- Thickness (ASTM D5199).
- Tensile characteristics (yield strength, elongation at yield, break strength, elongation at break) (ASTM D638).
- Interface shear strength testing as described in the Project Specifications.
  Direct shear testing for interface strength shall be carried out in accordance
  with ASTM D-5321 "Standard Test Method for Determining the Coefficient
  of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the
  Direct Shear Method." Issues and procedures related to soil preparation shall
  be governed by ASTM D3080.
- Puncture resistance (ASTM D4833).

Where optional procedures are noted in the test method, the requirements of the Project Specifications shall prevail.

#### 6.1.3.2 Sampling and Testing Frequency

Unless otherwise specified, conformance samples shall be taken and tested at a rate of one per lot or one per 100,000 square feet, whichever results in the greater number of tests. Testing for interface shear will be conducted at a rate of one per 200,000 square feet.

#### **6.1.3.3 Sampling Procedures**

Samples shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be 3 ft. long by the roll width. The Geotechnical CQA Monitors shall mark the machine direction on the samples with an arrow, and the Liner Manufacturer's roll identification number.

### 6.1.3.4 Test Results

The results of Conformance Testing will be documented on the appropriate forms and the Geotechnical CQA Officer shall examine all conformance testing results and report any non-conformance to the Construction Manager, the Contractor and the Lining Subcontractor.

All specimens tested shall pass. If any specimen fails, the entire sample shall be considered as a failure and rejected. In this event, the material represented by the sample shall be considered nonconformant with the Specifications, and corrective measures shall be implemented. Corrective measures shall include a rerun of the conformance testing using a portion of the same sample. If the second test passes, the Geotechnical CQA Officer may assume an error was made in the first test and

the HDPE material can be accepted. If the second test fails, the Liner Subcontractor shall remove all material represented by the sample from the work area.

All conformance test results must be approved by the Construction Manager prior to the HDPE represented by the test being approved for deployment/installation. The decision of the Construction Manager shall be final.

#### 6.1.4 HDPE INSTALLATION

#### 6.1.4.1 Earthwork

#### **Surface Preparation**

The Contractor shall be responsible for preparing the supporting soil according to the Project Specifications.

Prior to liner installation, the Contractor and Liner Subcontractor shall verify and the Construction Manager and Geotechnical CQA Monitor shall observe that:

- All lines and grades have been checked by survey and approved by the Construction Manager.
- The subgrade has been prepared in accordance with the Project Specifications.
- The surface has been rolled and compacted to be free of surface irregularities, loose soil, and protrusions.
- The supporting soil surfaces do not contain stones or other sharp protrusions which could damage the HDPE.
- There are no excessively soft areas which could result in HDPE damage.
- All construction stakes, hubs or other items used for grade control and/or verification have been removed.
- The Liner Subcontractor has certified in writing that the surface on which the HDPE will be installed is acceptable using an appropriate form (Form B-3 attached).

The certificate of acceptance shall be given by the Liner Subcontractor to the Contractor and the Construction Manager prior to commencement of HDPE installation in the area under consideration. The Geotechnical CQA Monitors shall have a copy of this certificate before installation of HDPE commences in any given area.

After the supporting surface has been accepted by the Contractor and Liner Subcontractor, it shall be the Contractor and Liner Subcontractor's responsibility to indicate to the Construction Manager any change in the supporting soil condition that may require repair work. If the Construction Manager concurs with the Contractor and Liner Subcontractor, then the Construction Manager shall coordinate the repair of the supporting surface. The subject area will also be observed by the Geotechnical CQA Monitors who shall have the authority to reject an area even after it has been accepted by the Contractor and Liner Subcontractor.

#### **Anchor Trench**

Anchor trenches shall be excavated to the lines and widths shown on the Project Drawings, prior to HDPE placement. The Geotechnical CQA Monitors shall observe that the anchor trenches have been constructed according to the project documents.

Slightly rounded corners shall be provided where the HDPE adjoins the trench so as to avoid sharp bends in the HDPE. No loose soil shall be allowed to underlie the HDPE in the anchor trench.

Anchor trench backfill shall be compacted to at least 90 percent relative compaction (ASTM D1557) as outlined in the Specifications.

Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics. The Geotechnical CQA Monitors shall observe the backfilling operation and advise the Construction Manager of any problems.

#### 6.1.4.2 HDPE Placement

#### Field Panel Identification

A field panel (sheet) is a discrete and integral area of HDPE which is to be seamed in the field along the edges to other field panels (i.e., a field panel is a roll or a single portion of a single roll). The Contractor or Liner Subcontractor shall assign each panel over 25 sq. feet an identification code which shall be agreed to and used by the Geotechnical CQA Monitors, Construction Manager, Contractor and the Liner Subcontractor. The Contractor or Liner Subcontractor shall locate the code with identifying roll number near the middle of panels less than 50 feet in length and at both ends of any panel over 50 feet in length. The Geotechnical CQA Monitors shall establish a chart showing correspondence between roll numbers, certification reports, and the panel identification code. The field panel identification code shall be used for all Geotechnical CQA records. An HDPE panel placement log will be maintained by the Geotechnical CQA Monitors on appropriate forms (Forms B-4 and B-5 attached).

#### Field Panel Placement

The Geotechnical CQA Monitors shall record the identification code, location and date of installation of each field panel.

During panel placement, the Geotechnical CQA Monitors shall:

- Verify that field panels are installed in general accordance with the panel layout plan, as approved or modified by the Construction Manager/Engineer.
- Observe the panel surface as it is deployed and record all panel defects and disposition of the defects. All repairs are to be made in accordance with the Specifications.
- Observe that the equipment used does not damage the HDPE by handling, trafficking, leakage of hydrocarbons, or by other means.
- Observe that the surface beneath the HDPE has not deteriorated since previous acceptance.
- Observe that there are no stones, construction debris, or other items beneath the HDPE which could cause damage.
- Observe that the HDPE is not dragged across an unprepared surface. If the HDPE is dragged across an unprepared surface, it shall be inspected for scratches and repaired or rejected, if necessary.
- Observe that the method used to unroll the panels does not cause scratches or crimps in the HDPE and does not damage the supporting soil surface.
- Record weather conditions including temperature, wind, and humidity. The HDPE shall not be deployed in the presence of excess moisture (fog, dew, mist, etc.), high winds and extreme temperatures as determined by the Geotechnical CQA Officer.
- Observe that people working during the installation of HDPE do not smoke, wear shoes which could damage the HDPE, or engage in activities which could damage the HDPE.
- Observe that the method used to deploy the HDPE panels minimizes wrinkles and that the panels are anchored to prevent movement by the wind.
- Observe that direct contact with the HDPE is minimized; (i.e., the HDPE is protected by geotextiles, extra HDPE, or other suitable materials, in areas where excessive traffic may be expected).

The Geotechnical CQA Monitors shall inform the Contractor, the Liner Subcontractor and the Construction Manager if the above conditions are not met.

After placement and prior to seaming, the Geotechnical CQA Monitors shall inspect each panel for damage. The Geotechnical CQA Monitors shall advise the Construction Manager which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels which have been rejected shall be marked and their removal from the work area recorded by the Geotechnical CQA Monitors.

#### 6.1.4.3 Field Seaming

The Contractor shall provide the Construction Manager and Geotechnical CQA Officer with a seam and panel layout plan and shall update this plan daily as the job proceeds. No panels shall be seamed until the panel layout plan has been approved by the Construction Manager. A seam numbering system shall be agreed to by the Geotechnical CQA Monitors, Construction Manager, Contractor and Liner Subcontractor prior to the start of seaming operations.

Prior to seaming, each seaming apparatus (welder) shall be tested in accordance with the Specifications to determine if the equipment is functioning properly. The Geotechnical CQA Monitors shall observe all trial weld operations and record the results. It is important that the trial welds be completed under conditions similar to those under which the panels will be seamed. If at any time the Geotechnical CQA Monitor believes that an operator or seaming apparatus is not functioning properly, a test shall be performed on a trial weld. If there are large changes in temperature, humidity, or wind speed, the trial weld test shall be repeated. Laboratory tests may be carried out at the discretion of the Geotechnical CQA Monitors to verify field test results.

During seaming operations the Geotechnical CQA Monitors shall observe that:

- The Liner Subcontractor has the number of welders and spare parts agreed to in the pre-construction meeting.
- Equipment used for seaming will not damage the HDPE.
- The extruder is purged prior to beginning a seam until all the heat-degraded extrudate is removed (extrusion welding only).
- Seam grinding has been completed less than 1 hour before seam welding (extrusion welding only).
- The ambient temperature measured 6 inches above the HDPE surface is between 40 and 105 degrees Fahrenheit and relative humidity is less than 80 percent.

- The end of welds more than 5 minutes old, are ground to expose new material before restarting a weld (extrusion welding only).
- The weld is free of dust and other debris.
- For cross seams, the seam is ground to a smooth incline prior to welding.
- The seams are overlapped in a downgradient direction with a minimum overlap of 4 inches.
- No solvents or adhesives are present in the seam area.
- The procedure used to temporarily hold the panels together does not damage the panels and does not preclude Geotechnical CQA testing.
- The panels are being seamed in accordance with the Project Plans and Specifications using approved equipment with gauges giving applicable temperatures.
- There is no free moisture in the weld area.
- The electric generator is placed on a smooth base such that no damage occurs to the HDPE.
- A smooth insulating plate or fabric is placed beneath the hot welding apparatus after use.
- The geomembrane is protected from damage in heavily trafficked areas.

The Geotechnical CQA Monitors shall log all appropriate temperatures and conditions, and shall log and report to the Geotechnical CQA Officer any non-compliance.

#### Trial Seams

Trial seam samples are not removed from installed seams, but are made along side the seaming work area by the Liner Subcontractor using a fragment of the same HDPE sheet and the same installation procedures as for the HDPE installation itself. As such, they are considered nondestructive samples. Such trial seams shall be made at the beginning of each seaming period (start of day, mid-day, and anytime the equipment is shut down or the seaming operation is suspended for more than 1/2 hour) for each piece of seaming equipment used that day. In addition, each welder shall make at least one trial seam each day. Trial seams shall be made under the same conditions as those anticipated for actual seams.

The trial seam sample shall be at least 3 ft. long by 1 ft. plus the seam width wide (after seaming) with the seam centered lengthwise. Seam overlap shall be as per the Specifications.

Two opposite specimens, each 1 inch wide, shall be cut from the trial seam sample by the Contractor and/or Liner Subcontractor. Under the observation of a Geotechnical CQA Monitor, the specimens shall be tested by the Liner Subcontractor in shear and peel using a field tensiometer to verify that seams satisfy peel and tensile strength requirements. If a specimen fails, the seaming equipment and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full trial welds are achieved. After completing a successful trial/nondestructive sample, the Contractor and/or Liner Subcontractor shall cut a 2' x 2' remnant from the sample and mark the welder number, date, time, ambient temperature, welder temperature, and speed and submit it to the Geotechnical CQA Monitor who will assign an identification number and enter the information on the non-destructive sample form.

The results of field tests carried out on trial seams shall be documented by the Geotechnical CQA Monitors on appropriate form (Form B-6 attached).

#### General Seaming Procedure

Unless otherwise specified, the general seaming procedure to be used by the Contractor and/or Liner Subcontractor shall be as follows:

- All HDPE seams shall be overlapped a minimum of four (4) inches.
- "Fishmouths" or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle in order to achieve a flat overlap. The cut "fishmouths" or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same HDPE extending a minimum of 6 inches beyond the cut in all directions. All corners of the patch shall be rounded with a 1-inch minimum radius.
- Adjacent to anchor trenches, seaming shall extend up the panels a minimum of 12 inches past the crest of the anchor trench.
- All cross seams shall be offset at least two feet from the cross seam of the adjacent panel and be extrusion or wedge welded where they intersect.

The Geotechnical CQA Monitors shall observe that the above seaming procedures are followed, and shall inform the Construction Manager if they are not.

## 6.1.5 CONSTRUCTION TESTING

#### 6.1.5.1 Nondestructive Seam Testing

The Contractor and/or Liner Subcontractor shall non-destructively test all field seams over their full length using a vacuum test unit, spark detector, or an air pressure test (for double wedge fusion seams only), as described below. The purpose of nondestructive tests is to check the continuity of seams. It does not provide any information on seam strength. Continuity testing shall be carried out as the seaming work progresses, not at the completion of field seaming.

#### Visual Inspection

All seams shall be visually evaluated by the Contractor and/or Liner Subcontractor as the installation progresses and again at completion of the installation. Defective and questionable sections shall be clearly marked and repaired as necessary.

#### Vacuum Box Testing

If the fillet weld, extrusion lap weld or single hot-wedge fusion lap weld technique is used to weld seams, the Contractor and/or Liner Subcontractor shall further test all seams and repairs in the HDPE by vacuum box. The vacuum box shall be an American Vacuum Seam Tester, Series A100 as manufactured by American Parts and Service Company, Alhambra, California, or an approved equal. All vacuum box testing shall be done in the presence of the Geotechnical CQA Monitor. The area to be tested shall be cleaned of all dust, debris, dirt and other foreign matter. A soap solution shall be applied to the test area with a brush, paint roller or spray bottle and a minimum vacuum of 10 inches of mercury (Hg) (5 psi) shall be induced and held as long as necessary to visually inspect and mark for repair any suspicious areas as evidenced by bubbles in the soap solution.

#### **Spark Testing**

If the fillet weld is used to weld seams, the Contractor and/or Liner Subcontractor may, in lieu of vacuum box testing, test all seams and repairs in the HDPE liner by using a high voltage spark detector, similar to Tinker and Rasor Holiday Detector (Model AP-W). The setting of the detector shall be 20,000 volts. In order to conduct this test, all seams to be tested shall be provided with 24-30 gauge copper wires properly embedded in the seams and grounded. All spark testing shall be done in the presence of the Geotechnical CQA Monitor. All defective areas shall be marked for repair.

#### Air Pressure Test

If the double hot-wedge welding technique is used, the Contractor and/or Liner Subcontractor shall further test all seams in the HDPE lining by using the air pressure test which consists of inserting a needle with gauge in the air space between welds. Air shall be pumped to 40 psi within the weld void and held for at least 5 minutes. If the pressure loss exceeds 2 psi within the weld void during air pressure testing, the outside weld edge (not free edge) shall be sprayed with a soap solution and visually examined for bubbles. If no bubbles appear, the problem is with the inside weld and the seam is acceptable. If any bubbles appear, the defect shall be repaired by extrusion welding and tested by vacuum box and spark detector.

If pressure loss is not more than 2 psi, the opposite end of the seam will be punctured to release the air. If a blockage is present, it will be located and tests on both sides of the blockage will be completed. All penetration holes created during testing shall be sealed by patching and extrusion welding.

#### **Electrical Leak Location Survey**

To aid in CQA monitoring of the geomembrane construction, an independent contractor will conduct an electrical leak location survey as part of the final quality control for the geomembrane installation. The method is designed to identify holes in the geomembrane liner after the LCRS gravel, or LCRS gravel and operations layer soil, has been placed. The leak location survey contractor will make point-by-point electrical measurements on the soil above and below the liner. By this process, because the geomembrane liner is an electrical insulator, current will flow only through leaks in the liner, producing localized anomalous areas of high current density near the leaks. Any identified electrical anomaly will be investigated and the liner repaired as described in Section 6.1.6, as necessary.

#### Responsibilities of the Geotechnical CQA Monitors

The Geotechnical CQA Monitor/Officer shall:

- Observe and record the continuity of all testing.
- Record the location seam/panel number, date, time, equipment number, Geotechnical CQA Monitor name, test number, welding technician's name, weld, sheet and ambient temperatures and results of all testing on appropriate forms (Form B-7 attached).
- Mark the failed areas with a waterproof marker compatible with the lining material and inform the Contractor and/or Liner Subcontractor and the Construction Manager of any required repairs.

- Observe that all testing is completed in accordance with the Project Specifications.
- Observe that all repairs are completed and tested in accordance with the Project Specifications.

### 6.1.5.2 Destructive Seam Testing

Destructive seam tests shall be performed at selected locations. The purpose of these tests is to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

Destructive sampling involves samples which have been removed from the installed field seams by the Contractor/Liner Subcontractor. Test locations shall be determined at the discretion of the Geotechnical CQA Monitors and the Contractor/Liner Subcontractor shall not be informed in advance of the locations where the seam samples will be made or will be removed.

Destructive samples shall be delivered to the Geotechnical CQA Officer by the Contractor/Liner Subcontractor and shipped to the Independent Testing Laboratory. All costs associated with the collection, repair, shipping and testing of destructive samples will be borne by the Contractor/Liner Subcontractor.

A minimum of one destructive sample per 500 feet of field seam shall be obtained. This average frequency will be used for the entire installation with the actual frequency of samples based on performance as determined by the Geotechnical CQA Officer.

Additional samples may be removed if the Geotechnical CQA Monitor observes a suspect seam.

### **6.1.5.3 Sampling Procedures**

Samples shall be made or removed by the Contractor/Liner Subcontractor at locations selected by the Geotechnical CQA Monitors as the seaming operation progresses. The Geotechnical CQA Monitor shall:

- Observe making and/or removal of samples.
- Mark each sample with an identifying number which contains the seam number. (For nondestructive samples the seam number welded just prior to making a sample will be marked on the sample).
- Record sample locations on the panel layout drawing and enter the information on a Destructive Sample Log Form.

- Record the sample location, date and time taken, weather conditions, and reason the sample was made and/or taken (e.g., random sample, visual appearance, result of a previous failure, etc.).
- Mark sample identifying number on HDPE adjacent to the location where the sample was taken.

All holes in the HDPE resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures described herein. The continuity of the new seams in the repaired area shall be tested according to procedures described herein.

### 6.1.5.4 Size of Samples

Two types of samples shall be made or removed at each location. First, two samples shall be removed for field testing. Each of these samples shall be 1 inch wide with a length of 12 inches plus the seam width. For destructive sampling, the sample shall be taken perpendicular to the seam and the distance between these two samples shall be 38 inches. Samples designated for laboratory testing shall be that portion of seam located between the two samples taken for field testing. The samples for laboratory testing shall be 36 inches long with a width of 12 inches plus the seam width. The seam shall be centered lengthwise. The samples for laboratory testing shall be cut into three equal parts and distributed as follows:

- One part for the Independent Testing Laboratory for testing.
- One part to the Contractor/Liner Subcontractor.
- One part to the Construction Manager for archive storage.

### 6.1.5.5 Field Testing

The two 1 inch wide samples shall be tested in the field for peel adhesion and bonded seam strength (shear) by the Contractor/Liner Subcontractor, and shall not fail in the seam, but shall have a film tearing bond (FTB). If one or both of the samples fails in either peel or shear, the Contractor/Liner Subcontractor can, at his/her discretion, (1) reconstruct or cap strip the seam between passed test locations, or (2) take two additional test samples 10 feet on either side of the point of the failed test and repeat this procedure. If the second test passes, the Contractor/Liner Subcontractor shall reconstruct or cap strip the same between the two passed test locations. If subsequent tests fail, the procedure is repeated until the length of the poor quality seam is established. Repeated failures indicate that either the seaming equipment and/or operator is not performing properly, and appropriate action shall be taken.

### 6.1.5.6 Laboratory Testing

Once the field tests have passed, a sample shall be recovered from between passing field sample locations for testing by the Independent Testing Laboratory. Destructive test samples shall be packaged and shipped to the laboratory by the Geotechnical CQA Monitors and will be handled in a manner which will not damage the test sample. The Construction Manager will be responsible for storing the archive samples.

All specimens of a field weld sample tested by the Independent Testing Laboratory shall pass. If any specimen fails, the entire sample shall be considered as a failure, and the field weld shall be rejected. In this event, the field seam(s) shall be rejected as being nonconformant with the Specifications, and corrective measures shall be implemented.

For destructive samples which have failed, corrective measures shall include a rerun of the weld test using the same sample. If the second test passes, the Geotechnical CQA Monitor may assume an error was made in the first test and the field seam may be accepted. If the second test fails, the Contractor/Liner Subcontractor shall reconstruct or cap strip the field seam between any two previous passed seam locations which include the failed seam or shall go on both sides of the failed seam location (10-feet minimum), take another sample each side and test both in the independent laboratory.

If both samples pass, the Contractor/Liner Subcontractor shall reconstruct or cap strip the field seam between the two passing locations. If either fails, the Contractor/Liner Subcontractor shall repeat the process of taking samples for testing by the Independent Testing Laboratory. In all cases, acceptable field seams must be bounded by two passed test locations. In cases involving more than 50 feet of reconstructed or cap stripped seam, the reconstructed or cap stripped seam shall also be tested. The results of the Independent Testing Laboratory govern seam acceptance. In no case shall field testing of installed seams be used for final acceptance.

Testing shall include peel adhesion and bonded seam strength (shear; ASTM D6392). At least five specimens each shall be tested for peel and sheer. Minimum test values are presented in the Specifications. The Independent Testing Laboratory shall provide test results within 24 hours after receipt of samples for testing. Certified test results shall be provided within 5 days. The Geotechnical CQA Monitor shall document all test results on an appropriate form (Form B-8 attached) and shall immediately notify the Geotechnical CQA Officer, Construction Manager and/or Contractor/Liner Subcontractor in the event of a failed test.

The Contractor/Liner Subcontractor's laboratory test results shall be presented to the Geotechnical CQA Officer for comments.

### 6.1.6 <u>DEFECTS AND REPAIRS</u>

### 6.1.6.1 Identification

All seams and non-seam areas of the HDPE shall be examined by the Geotechnical CQA Monitors for identification of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter. Because light reflected by the HDPE helps to detect defects, the surface of the HDPE shall be clean at the time of examination. The HDPE surface shall be cleaned by the Contractor/Liner Subcontractor if the amount of dust or mud inhibits examination.

Each suspect location as identified by the Geotechnical CQA Monitors, both in seam and non-seam areas, shall be non-destructively tested using the methods described herein, as appropriate. Each location which fails the nondestructive testing shall be marked by the Geotechnical CQA Monitor and then repaired and re-tested by the Contractor/Liner Subcontractor. Work shall not proceed with any materials which will cover locations which have been repaired until laboratory test results with passing values have been obtained.

### **6.1.6.2** Repair Procedures

Any portion of the HDPE with a flaw or which fails a nondestructive or destructive test shall be repaired in accordance with the Specifications. The Geotechnical CQA Monitor shall locate and describe all repairs on the appropriate forms. Repair procedures include:

- Patching used to repair large holes, tears, large panel defects, and destructive sample locations which are less than 25 sq. feet in total area.
- Extrusion used to repair relatively small defects in panels and seams.
- Capping used to repair failed welds or liner seams where welds cannot be non-destructively tested.
- Removal used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles) from the installed HDPE.

### 6.1.6.3 Seam Test Summary

Documentation of all nondestructive and destructive seam testing results, including repairs, shall be summarized by the Geotechnical CQA Officer on Form B-9 attached.

### 6.1.7 WRINKLES

When placing soil or drain materials over the HDPE, temperature changes or creep may cause wrinkles to develop in the HDPE. Any wrinkles which can fold over shall be repaired either by cutting out excess material or, if possible, allowing the HDPE to contract due to temperature reduction. In no case shall material be placed over the HDPE which could result in the HDPE folding. All folded HDPE shall be removed. No material shall be placed in areas where liner is not in contact with the supporting subgrade.

### 6.1.8 ANCHOR TRENCH

The anchor trench shall be adequately drained to prevent ponding or softening of the adjacent soils while the trench is open. The anchor trench shall be backfilled and compacted as outlined in the Specifications. Fill soils shall consist of on-site granular soil essentially free of organic and deleterious material and approved by the Geotechnical CQA Monitor and Construction Manager. The material shall have a maximum particle size of 1 inch.

Care shall be taken when backfilling the trenches to prevent any damage to the geosynthetics. The Geotechnical CQA Monitor shall observe the bottom of the trenches prior to fill placement to ensure they are free of loose and disturbed materials. The Geotechnical CQA Monitor shall also observe the backfilling and compaction operation, and shall notify the Geotechnical CQA Officer and the Construction Manager of work performed not in accordance with the Project Specifications.

### 6.1.9 HDPE ACCEPTANCE

The Contractor/Liner Subcontractor shall retain all ownership and responsibility for the HDPE until acceptance by the Owner. The HDPE shall be accepted by Owner when:

- The installation is finished and approved.
- All seams have been inspected and approved.
- All required laboratory tests have been completed and approved.

- All required Contractor/Liner Subcontractor supplied documentation has been received and approved.
- All record drawings have been completed and approved.

### 6.1.10 LINER MATERIALS

The Geotechnical CQA procedures indicated in this section are intended to allow the installation of materials in contact with the HDPE without causing damage to it.

Important points for Quality Assurance of materials in contact with HDPE include:

- A geotextile or drainage medium approved by the Construction Manager shall be installed above the HDPE.
- Equipment used for placing soil shall not be driven directly on the HDPE/geotextile.
- In heavily trafficked areas, such as access ramps, soil thickness should be at least three (3) feet over the geosynthetics.
- Placement of soils, gravels, sand or other types of earth materials on top of the HDPE/geotextile shall not be performed until all destructive and nondestructive testing has been performed and accepted.
- Placement of overlying earth materials shall be performed in a manner to minimize wrinkles. Equipment operators shall be briefed on methods of placement relative to thermal expansion and contraction of the HDPE.
- Soil material(s) placed on top of the HDPE/geotextile shall be stockpiled and displaced off the stockpile to create a cascading effect of the material on top of the HDPE/geotextile.

The Geotechnical CQA Monitors shall inform the Geotechnical CQA Officer if the above conditions are not fulfilled.

### 6.2 GEOSYNTHETIC CLAY LINER (GCL)

The Contractor/GCL Manufacturer shall provide the Construction Manager with the following documentation:

 A properties sheet for geotextile and bentonite materials which includes all specified properties measured using test methods indicated in the Project Specifications.

- Certificates for raw bentonite and geotextile materials which indicate that materials provided meet or exceed all applicable specification requirements.
- Manufacturer's Quality Control Certificates.
- Internal shear strength certificate in accordance with specification requirements.
- A panel placement plan.

The Geotechnical CQA Officer shall verify that:

- The property values certified by the GCL Manufacturer meet or exceed the Project Specifications.
- The measurement of properties by the GCL Manufacturer are properly documented and the test methods used are acceptable.

Prior to shipment, the Contractor/GCL Manufacturer shall provide the Construction Manager with a quality control certificate for each GCL roll which is intended for use on the project. The quality control certificate(s) shall be signed by a responsible person employed by the Manufacturer, and shall include roll numbers and identification.

The Geotechnical CQA Officer shall:

- Verify that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls to be delivered.
- Review the quality control certificates and verify that the certified roll properties meet the Project Specifications.

### 6.2.1 GCL DELIVERY

The Contractor/GCL Subcontractor shall submit for approval by the Construction Manager, method(s) for handling and storage of GCL material(s) prior to installation. The Geotechnical CQA Monitor shall observe that:

- Equipment used to unload the rolls will not damage the material.
- Care is used to unload the rolls.
- All documentation required by the specifications has been received.

Upon delivery at the site, the Geotechnical CQA Monitor(s) shall conduct a surface inspection of all rolls for defects and damage. This inspection shall be conducted without unrolling rolls unless defects or damage are found or suspected. The Geotechnical CQA Monitor(s) shall report to the Construction

Any damaged rolls shall be rejected and removed from the site or stored at a location, designated by the Construction Manager separate from accepted rolls. All rolls which do not have proper documentation from the Manufacturer shall also be stored at a separate location until all documentation has been received and approved. A log of the GCL material(s) received shall be maintained by the Geotechnical CQA Monitor(s).

The Construction Manager shall designate storage space in a location (or several locations) on-site. Storage space shall be protected by the Contractor from theft, vandalism, damage from the actions of Manufacturer, weather, animals and other sources. The Geotechnical CQA Monitor(s) shall observe that the materials are stored in accordance with Manufacturers recommendations and are protected against damage pursuant to ASTM D4873.

### 6.2.2 GCL CONFORMANCE TESTING

### 6.2.2.1 Tests

Upon delivery of the GCL material(s), the Geotechnical CQA Monitor shall ensure that the Contractor obtains and forwards samples to the approved Independent Testing Laboratory for testing of conformance with the design specifications. Conformance tests, including interface direct shear, will be performed as detailed in the Project Specifications.

Where optional procedures are noted in the test method, the requirements of the specifications shall prevail. Updated or alternative test methods may be used to determine the physical properties of the GCL materials at the discretion of the Construction Manager.

The results of Conformance Testing will be documented by the Geotechnical CQA Officer.

### 6.2.2.2 Sampling Procedures

Samples shall be taken across the entire width of the roll(s) and shall not include the first three feet. Unless otherwise specified, samples shall be three (3) feet long by the roll width. The Geotechnical CQA Monitor shall mark the machine direction on the samples with an arrow, and the Manufacturers roll identification number.

### 6.2.2.3 Test Results

The Geotechnical CQA Officer shall examine all results from the laboratory conformance testing. All specimens tested shall pass. If any specimen fails, the entire sample shall be considered as a failure and rejected. In this event, the GCL

material represented by the sample shall be considered non-conformant with the specifications, and corrective measures shall be implemented. Corrective measures shall include a rerun of the conformance testing using a portion of the same sample. If the second test passes, the Geotechnical CQA Officer may assume an error was made in the first test and the GCL material can be accepted. If the second test fails, the Contractor/GCL Subcontractor shall remove all material represented by the sample from the work area. The decision of the Construction Manager shall be final.

### 6.2.3 GCL INSTALLATION

### 6.2.3.1 Surface Preparation

Prior to installation, the Construction Manager and Geotechnical CQA Monitor(s) shall observe that:

- All lines and grades have been verified by the project surveyor.
- The supporting surface does not contain rocks or irregular surfaces which could damage the GCL.
- There are no excessive soft spots or ponded water which could result in damage to the GCL.
- The Contractor/GCL Subcontractor has certified in writing that the surface on which the GCL will be installed is acceptable.
- The Contractor/GCL Subcontractor shall give each GCL panel an
  identification number which shall be agreed to and used by the Geotechnical
  CQA Monitor(s) and the Contractor/GCL Subcontractor. The Geotechnical
  CQA Monitor shall establish a chart showing correspondence between roll
  numbers, certification reports and panel numbers.

During placement, the Geotechnical CQA Monitor(s) shall:

- Observe the GCL as it is placed and record all defects and disposition of the defects (panel rejects, patch installed, etc.). All repairs are to be made in accordance with the Project Specifications.
- Observe that Manufacturer's defects do not exceed that allowed by the Project Specifications.
- Observe that equipment used does not damage the GCL by handling, traffic, leakage of hydrocarbons, or other means.

- Observe that people working during installation of the GCL do not smoke, wear shoes that could damage the GCL, or engage in other activities that could damage the GCL.
- Observe that the GCL is anchored to prevent movement by the wind.
- Observe that adjacent panels of GCL are properly overlapped and the proper amount and type of bentonite is installed along the full length of all seams.
- Observe that the number of panels deployed are covered and protected from moisture at the end of the work day.

The Geotechnical CQA Monitor(s) shall inform both the Contractor/GCL Subcontractor and the Construction Manager if the above minimum conditions are not met.

The Contractor/GCL Subcontractor shall provide the Construction Manager with a panel layout plan, and shall update this plan daily as the job proceeds. No GCL shall be placed until the panel layout plan has been approved by the Construction Manager. During panel placement, the Geotechnical CQA Monitor(s) shall also observe the following:

- That GCL material is cut with an approved GCL cutter, and is not torn or ripped.
- The bentonite to be used on all seams meets the requirements of the Project Specifications.
- That the panels are overlapped and sealed in accordance with the Project Plans and Specifications.

### 6.2.4 REPAIRS

Any necessary repairs to the GCL shall be made with approved GCL material, using approved overlaps, materials, equipment and techniques. The patch size shall be 12 inches or larger in all directions than the area to be patched.

### 6.3 GEOTEXTILES

The Contractor/Liner Manufacturer shall provide the Construction Manager with the following documentation:

- A properties sheet which includes all specified properties measured using test methods indicated in the specifications.
- A description of the sampling procedure and appropriate test results.

• A certification that values given in the properties sheet are guaranteed by the Liner Manufacturer.

The Geotechnical CQA Officer shall verify that:

- The property values certified by the Liner Manufacturer meet or exceed the project specifications.
- The measurement of properties by the Liner Manufacturer are properly documented and the test methods used are acceptable.

Prior to shipment, the Contractor/Liner Manufacturer shall provide the Construction Manager with a quality control certificate for each roll of geotextile. The quality control certificate shall be signed by a responsible person employed by the Liner Manufacturer, and shall include roll number and identification.

The Geotechnical CQA Officer shall:

- Verify that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls to be delivered.
- Review the quality control certificates and verify that the certified roll properties meet the project specifications.

### 6.3.1 GEOTEXTILE DELIVERY

The Contractor/Liner Subcontractor shall submit for approval by the Construction Manager, method(s) for handling and storage of geotextile material(s) prior to installation. The Geotechnical CQA Monitor shall observe that:

- Equipment used to unload the rolls will not damage the geotextile.
- Care is used to unload the rolls.
- All documentation required by the Specifications has been received.

Upon delivery at the site, the Geotechnical CQA Monitors shall conduct a surface inspection of all rolls for defects and damage. This inspection shall be conducted without unrolling rolls unless defects or damage are found or suspected. The Geotechnical CQA Monitors shall indicate to the Geotechnical CQA Officer any rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws. These rolls shall be clearly marked as rejected.

Any damaged rolls shall be rejected and removed from the site or stored at a location, designated by the Construction Manager separate from accepted rolls. All rolls which do not have proper documentation from the manufacturer shall also be stored at a separate location until all documentation has been received and

approved. A log of the geotextile material(s) received shall be maintained by the Geotechnical CQA Monitors on an appropriate form (Form B-10 attached).

The Construction Manager shall designate storage space in a location (or several locations) on-site. Storage space shall be protected by the Contractor from theft, vandalism, damage from the actions of man, weather, animals and other sources. The Geotechnical CQA Monitors shall observe that the material is not stored directly on the ground and that storage of the geotextile provides protection against damage pursuant to ASTM D4873.

### 6.3.2 GEOTEXTILE CONFORMANCE TESTING

### 6.3.2.1 Tests

Upon delivery of the geotextile, the Geotechnical CQA Monitor shall ensure that samples are obtained and forwarded to an Independent Laboratory for testing of conformance with the design specifications. As a minimum, the following tests will be performed to ensure that geotextile materials are in conformance with the design specifications.

- Thickness (ASTM D1777)
- Mass per unit Area (ASTM D3776)
- Burst Strength (ASTM D3786)
- Puncture Strength (ASTM D4833)

- Permittivity (ASTM D4491)
- Grab Tensile Tests (ASTM D4632)
- Apparent Opening Size (ASTM D4751)
- Appropriate interface shear testing as noted of the Specifications

Where optional procedures are noted in the test method, the requirements of the Specifications shall prevail. Updated or alternative ASTM Test Methods may be used to determine the physical properties of the geotextile materials at the discretion of the Construction Manager.

The results of Conformance Testing will be documented by the Geotechnical CQA Officer on an appropriate form (Form B-11 attached).

### **6.3.2.2 Sampling Procedures**

Samples shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three feet long by the roll width. The Geotechnical CQA Monitor shall mark the machine direction on the samples with an arrow, and the Manufacturer's roll identification number.

Unless otherwise specified, samples shall be taken at a rate of one per lot or one per 100,000 square feet, whichever results in the greater number of samples.

### 6.3.2.3 Test Results

The Geotechnical CQA Officer shall examine all results from the laboratory conformance testing. All specimens tested shall pass. If any specimen fails, the entire sample shall be considered as a failure and rejected. In this event, the geotextile material represented by the sample shall be considered nonconformant with the Specifications, and corrective measures shall be implemented. Corrective measures shall include a rerun of the conformance testing using a portion of the same sample. If the second test passes, the Geotechnical CQA Officer may assume an error was made in the first test and the geotextile material can be accepted. If the second test fails, the Contractor/Liner Subcontractor shall remove all material represented by the sample from the work area. The decision of the Construction Manager shall be final.

### 6.3.3 GEOTEXTILE INSTALLATION

### 6.3.3.1 Surface Preparation

Prior to installation, the Construction Manager and Geotechnical CQA Monitors shall observe that:

- All lines and grades have been verified.
- The subgrade has been prepared in accordance with the Project Specifications and the supporting surface does not contain rocks or irregular surfaces which could damage the geotextile.
- There are no excessively soft areas which could result in damage to the geotextile.
- The Contractor/Liner Subcontractor has certified in writing that the surface on which the geotextile will be installed is acceptable.

### 6.3.3.2 Placement

The Contractor/Subcontractor shall give each geotextile panel an identification number which shall be agreed to and used by the Geotechnical CQA Monitors and the Contractor/Liner Subcontractor. The Geotechnical CQA Monitor shall establish a chart showing correspondence between roll numbers, certification reports, and panel numbers on an appropriate form (Form B-12 attached).

During panel placement, the Geotechnical CQA Monitor shall:

- Observe the geotextile as it is placed and record all defects and disposition of the defects (panel rejected, patch installed, etc.). All repairs are to be made in accordance with the Specifications.
- Observe that equipment used does not damage the geotextile by handling, traffic, leakage of hydrocarbons, or other means;
- Observe that people working during installation of geotextile do not smoke, wear shoes that could damage the geotextile, or engage in other activities that could damage the geotextile
- Observe that the geotextile is anchored to prevent movement by the wind.
- Observe that adjacent panels of geotextile are overlapped a minimum of 18 inches where the fabric is not seamed (welded or sewn). When seamed, a three inch minimum overlap will be required.

The Geotechnical CQA Monitors shall inform both the Contractor/Liner Subcontractor and the Geotechnical CQA Officer if the above minimum conditions are not met.

The Contractor/Liner Subcontractor shall provide the Construction Manager with a panel layout plan, and shall update this plan daily as the job proceeds. No geotextile shall be placed until the panel layout plan has been approved by the Construction Manager. During geotextile placement, the Geotechnical CQA Monitors shall observe that:

- The geotextile is cut only with an approved geotextile cutter, and is not torn or ripped.
- The thread and sewing machinery meet the Project requirements (if sewing is the elected method of joining panels).
- The panels are being overlapped or joined in accordance with the Project Plans and Specifications.
- Any roll of geotextile with a tear exceeding 10 percent of roll width is removed and replaced.

### 6.3.4 REPAIRS

Any necessary repairs to the geotextile shall be made with the geotextile material itself, using approved overlaps or sewing systems, equipment and techniques. The patch size shall be 18 inches or larger in all directions than the area to be patched and all corners shall be rounded.

### 6.4 **GEOCOMPOSITE**

The Contractor/Liner Manufacturer shall provide the Construction Manager with the following documentation:

- A properties sheet which includes all specified properties measured using test methods indicated in the specifications.
- A description of the sampling procedure and appropriate test results.
- A certification that values given in the properties sheet are guaranteed by the Liner Manufacturer.

The Geotechnical CQA Officer shall verify that:

- The property values certified by the Liner Manufacturer meet or exceed the project specifications.
- The measurement of properties by the Liner Manufacturer are properly documented and the test methods used are acceptable.

Prior to shipment, the Contractor/Liner Manufacturer shall provide the Construction Manager with a quality control certificate for each roll of geocomposite. The quality control certificate shall be signed by a responsible person employed by the Liner Manufacturer, and shall include roll number and identification.

The Geotechnical CQA Officer shall:

- Verify that the quality control certificates have been provided at the specified frequency for all rolls, and that each certificate identifies the rolls to be delivered.
- Review the quality control certificates and verify that the certified roll properties meet the project specifications.

### 6.4.1 GEOCOMPOSITE DELIVERY

The Contractor/Liner Subcontractor shall submit for approval by the Construction Manager, method(s) for handling and storage of geocomposite material(s) prior to installation. The Geotechnical CQA Monitor shall observe that:

- Equipment used to unload the rolls will not damage the geocomposite.
- Care is used to unload the rolls.
- All documentation required by the Specifications has been received.

Upon delivery at the site, the Geotechnical CQA Monitors shall conduct a surface inspection of all rolls for defects and damage. This inspection shall be conducted without unrolling rolls unless defects or damage are found or suspected. The Geotechnical CQA Monitors shall indicate to the Geotechnical CQA Officer any

rolls, or portions thereof, which should be rejected and removed from the site because they have severe flaws.

Any damaged rolls shall be marked as rejected and removed from the site or stored at a location, designated by the Construction Manager separate from accepted rolls. All rolls which do not have proper documentation from the manufacturer shall also be stored at a separate location until all documentation has been received and approved. A log of the geocomposite material(s) received shall be maintained by the Geotechnical CQA Monitors.

The Construction Manager shall designate storage space in a location (or several locations) on-site. Storage space shall be protected by the Contractor from theft, vandalism, damage from the actions of man, weather, animals and other sources. The Geotechnical CQA Monitors shall observe that the material is not stored directly on the ground and that storage of the geocomposite provides protection against damage pursuant to ASTM D4873.

### 6.4.2 GEOCOMPOSITE CONFORMANCE TESTING

### 6.4.2.1 Tests

Upon delivery of the geocomposite, the Geotechnical CQA Monitor shall ensure that samples are obtained and forwarded to a GAI certified Independent Laboratory for testing of conformance with the design specifications. Conformance sampling and testing will be conducted in accordance with Section D of the Project Specifications.

- Thickness (ASTM D1777)
- Mass per unit area (ASTM D3776)
- Hydraulic Transmissivity (ASTM D4716
- Carbon Black Content (ASTM D1603)
- Tensile Strength (machine direction; ASTM D1682)

Where optional procedures are noted in the test method, the requirements of the Specifications shall prevail. Updated or alternative ASTM Test Methods may be used to determine the physical properties of the geocomposite materials at the discretion of the Construction Manager.

The results of Conformance Testing will be documented by the Geotechnical CQA Officer.

### 6.4.2.2 Sampling Procedures

Samples shall be taken across the entire width of the roll and shall not include the first three feet. Unless otherwise specified, samples shall be three feet long by the

roll width. The Geotechnical CQA Monitor shall mark the machine direction on the samples with an arrow, and the Manufacturer's roll identification number.

Unless otherwise specified, samples shall be taken at a rate of one per lot or one per 100,000 square feet, whichever results in the greater number of samples.

### 6.4.2.3 Test Results

The Geotechnical CQA Officer shall examine all results from the laboratory conformance testing. All specimens tested shall pass. If any specimen fails, the entire sample shall be considered as a failure and rejected. In this event, the geocomposite material represented by the sample shall be considered nonconformant with the Specifications, and corrective measures shall be implemented. Corrective measures shall include a rerun of the conformance testing using a portion of the same sample. If the second test passes, the Geotechnical CQA Officer may assume an error was made in the first test and the geotextile material can be accepted. If the second test fails, the Contractor/Liner Subcontractor shall remove all material represented by the sample from the work area. The decision of the Construction Manager shall be final.

### 6.4.3 GEOCOMPOSITE INSTALLATION

### 6.4.3.1 Surface Preparation

Prior to installation, the Construction Manager and Geotechnical CQA Monitors shall observe that:

- All lines and grades have been verified.
- The subgrade has been prepared in accordance with the Project Specifications and the supporting surface does not contain rocks or irregular surfaces which could damage the geocomposite.
- There are no excessively soft areas which could result in damage to the geocomposite.
- All construction stakes and hubs have been removed.
- The Contractor/Liner Subcontractor has certified in writing that the surface on which the geocomposite will be installed is acceptable.

### 6.4.3.2 Placement

The Contractor/Subcontractor shall give each geocomposite panel an identification number which shall be agreed to and used by the Geotechnical CQA Monitors and the Contractor/Liner Subcontractor. The Geotechnical CQA Monitor shall establish a chart showing correspondence between roll numbers, certification reports, and panel numbers.

During panel placement, the Geotechnical CQA Monitor shall:

- Observe the geocomposite as it is placed and record all defects and disposition of the defects (panel rejected, patch installed, etc.). All repairs are to be made in accordance with the Specifications.
- Observe that equipment used does not damage the geocomposite by handling, traffic, leakage of hydrocarbons, or other means.
- Observe that people working during installation of geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in other activities that could damage the geocomposite.
- Observe that the geocomposite is anchored to prevent movement by the wind.
- Observe that adjacent panels of geocomposite are overlapped a minimum of 18 inches where the fabric is not seamed (welded or sewn). When seamed, a three inch minimum overlap will be required.

The Geotechnical CQA Monitors shall inform both the Contractor/Liner Subcontractor and the Geotechnical CQA Officer if the above minimum conditions are not met.

The Contractor/Liner Subcontractor shall provide the Construction Manager with a panel layout plan, and shall update this plan daily as the job proceeds. No geocomposite shall be placed until the panel layout plan has been approved by the Construction Manager. During geocomposite placement, the Geotechnical CQA Monitors shall observe that:

- The geocomposite is cut only with an approved cutter, and is not torn or ripped.
- Geocomposite seaming equipment meet the Project requirements.
- The panels are being overlapped or joined in accordance with the Project Plans and Specifications.
- Any damaged roll of geocomposite is removed and replaced.

### 6.4.4 REPAIRS

Any necessary repairs to the geocomposite shall be made with the geocomposite material itself, using approved overlaps or seaming systems, equipment, and techniques. The patch size shall be 18 inches or larger in all directions than the area to be patched and all corners shall be rounded.

### 7.0 DOCUMENTATION

The Geotechnical CQA Plan depends on thorough monitoring and documentation of all construction activities. Therefore, the Geotechnical CQA Officer shall document that all Geotechnical CQA requirements have been addressed and satisfied. Documentation shall consist of daily reports, construction problem reports, photographs, design and specification revisions, and a certification report.

### 7.1 DAILY SUMMARY REPORTS

Daily summary reports provide a chronological framework for identifying and recording all other reports and shall consist of field notes, summary of the daily meeting with the Contractor/Liner Subcontractor, observation and data sheets (including a record of field and/or laboratory tests) and construction corrective measures reports. This information shall be submitted daily to the Geotechnical CQA Officer for review and approval. The summary of the daily meeting with the Contractor/Liner Subcontractor shall include:

- Date, project name, and location.
- Names of parties attending.
- Scheduled activities.
- Items discussed.
- Signature of Geotechnical CQA Monitor.

The corrective measures report will include detailed descriptions of materials and/or workmanship that do not meet a specified design and will be cross referenced to the specific inspection data sheets where the problem was identified and corrected.

### 7.2 OBSERVATION AND TEST DATA REPORTS

Observation and test data reports shall include:

- Date, project name, and location.
- Weather data.
- A reduced scale site plan showing work areas, including sample and test locations.
- A description of ongoing construction.

- A summary of test results identified as passing, failing, or, in the event of a failed test, retest.
- Test equipment calibrations, if applicable.
- A summary of decisions regarding acceptance of the work and/or corrective actions taken.
- The signature of the Geotechnical CQA Monitor.

A summary of observation and test data reports shall be submitted on a schedule mutually agreeable to the Construction Manager and Geotechnical CQA Officer.

### 7.3 CONSTRUCTION CORRECTIVE MEASURES REPORTS

These reports identify and document construction problems and solutions. They are intended to document problems involving significant rework, and are not intended to document problems which are easily corrected unless the problems are recurring. Each report shall include:

- A detailed description of the problem.
- The location and cause of the problem
- The solution to the problem.
- The personnel involved.
- Signatures of the Geotechnical CQA Officer and Construction Manager.

### 7.4 DESIGN AND SPECIFICATION REVISIONS

Design and specification revisions may be required during construction. In such cases, the Geotechnical CQA Officer shall notify the Construction Manager. Design and specification revisions shall become official only after written approval of the Construction Manager.

### 7.5 PHOTOGRAPHS

Construction activities will be photographed, including significant problems and remedial actions. The photographs will be identified by location, time, date, and photographer.

### 7.6 AS-BUILT PLANS

As-built plans shall be prepared by the Contractor/Subcontractor from surveying and base maps prepared by a Registered Land Surveyor. The Geotechnical CQA Monitors shall observe that the "As-Built" plans include:

- Dimensions of all field panels;
- Location of each panel relative to the surveyor's plan;
- Identification of all panels and seams (including manufacturer's roll identification numbers);
- Location of all patches and repairs;
- Location of all nondestructive and destructive test sampling:
- Identification of problems or unusual conditions.

### 7.7 FINAL CERTIFICATION REPORT

At completion of the work, the Geotechnical CQA Officer shall prepare and submit a final certification report. This report shall render an opinion as to whether the work was performed in compliance with the project plans and specifications.

As a minimum, the final certification report shall include:

- A summary of all construction activities;
- Laboratory and field test results;
- Observation and test data sheets;
- Sampling and testing location plans;
- A description of significant construction problems and the solutions of these problems;
- A list of revisions from the construction plans and specifications, and the justification for these revisions;
- A certification statement signed and sealed by a Civil Engineer or Certified Engineering Geologist registered in the State of California.

Upon completion of construction, the facility will store all original documents so that they are protected from damage throughout the post-closure maintenance period, yet can be readily accessed.

### B-1 FML RECEIVED

Geologists, Hydrogeologists and Engineers

PROJECT NO.: 9539

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

LOCATION: SAN DIEGO COUNTY, CA

Status I/P/F CQA Test Received CQA Sample Sent to Lab CQC Doc. Received Notes: Cumm. Sq. Ft. Rcvd. Total e Fe Area sq. ft. Width feet Status: Length feet Lot Number (Railcar) Roll Number QA Monitor Manufacturer: Date Received

l – In progress P – Pass F – Fail

CQC - Construction Quality Control CQA - Construction Quality Assurance

### B-1A GCL RECEIVED

GeoLogic Associates
Geologists, Hydrogeologists and Engineers

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

LOCATION: SAN DIEGO COUNTY, CA

COA Test Result CQA Test Received CQA Sample Sent to Lab COC Doc. Received Cumm. Sq. Ft. Rcvd. Total g Š Area sq. ft. Width feet Length feet Lot Number (Railcar) Roll Number PROJECT NO.: 9539 QA Monitor Date Received

Status:

l – In progress P – Pass F – Fail

Type: CQC - Construction Quality Control CQA - Construction Quality Assurance

Manufacturer:

Checked By:

Notes:

### B-1B

## GEOCOMPOSITE RECEIVED

GeoLogic Associates
Geologists, Hydrogeologists and Engineers

COUNTY, CA	Status	7/9/ F											
AN DIEGO (	COA Test	Result						-		·			
LOCATION: SAN DIEGO COUNTY, CA	COA Test	Received											
	COA Sample	Sent to Lab			-								
STEM CONS	COC Doc.	Received											
E LINER SY		Cumm. Sq. Ft. Revd. By Lot Total											
COMPOSIT	S												
NDFILL, (	AREA	₹ ģ											
CANYON LA		Length Width feet feet											
PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION	Lot Number	<u> </u>											
PROJ	Roll	Legenz Enz										ę	(for the way)
0.: 9539	8	Monitor											
PROJECT NO.: 9539	Date	Keceived											

l – In progress P – Pass F – Fail

CQC - Construction Quality Control CQA - Construction Quality Assurance

B-2

### FML CONFORMANCE TEST

Geologists, Hydrogeologists and Engineers

PROJECT NO.: 9539

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

LOCATION: SAN DIEGO COUNTY, CA

Test Number	Date	Roll Number	Lot Number (Railcar)	Туре					Roll	Roll	Material Represented	Status I/P/F	Remarks	
									feet	feet	Sq.Ft.			
FML	Specific	ation												
Accep	Acceptable L	imits	Acceptable Limits								<i>mmummum</i>		ununninnunnun.	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
									-					
		-	-											
										-				
					•									
				-										
								<del></del>						
Manufacturer:	Ľ			Stat	Status:	-	Notes:							7

l – In progr P – Pass

### **B-2A**

## GCL CONFORMANCE TEST

Geologists. Hydrogeologists and Engineers

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

PROJECT NO.: 9539

LOCATION: SAN DIEGO COUNTY, CA

Test Date Number		Roll Number	Lot Number (Railcar)	Type						Roll	Roll	Material Represented	Status 1/P/F	Remarks	
										feet	feet	<b>S4.P.</b>			
ummummummummum.	mununununu	ummumm.		Annunununun.			 · · · · · · · · · · · · · · · · · · ·	mmmammm	<i></i>			Mananana	Y III III III III III III III III III I		
	le Limit	ts	stable Limits			-	-								
								-							
						-									
								-							
										-	-				Ī
-															
															Ī
	-														
									-						
Manufacturer:				Status:	tus:		Notes:	<b>:8</b> :							1

l – In progress P – Pass F – Fail

### B-2B

## GEOCOMPOSITE CONFORMANCE TEST

GeoLogic Associates
Geologists, Hydrogeologists and Engineers

PROJECT NO.: 9539

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

LOCATION: SAN DIEGO COUNTY, CA

				I	T		<u> </u>	T	T	-	T	1	T		T	l .	1	7
Remarks																		
Status I/P/F																		
Material Represented	<b>8.F.</b>																	
Roll	feet																	
Roll	feet																	
																		Notes:
			3															ž
																-		
			V															
Type														•				Status:
Lot Number (Railcar)		Acceptable Limits																
Roll Number		imits																
Date		table Li	3															Ľ
Test Number		Acceptable	3						-									Manufacturer:

### **B-4**

# FML PANEL PLACEMENT LOG SUMMARY

Geologists, Hydrogeologists and Engineers

LOCATION: SAN DIFGO COUNTY CA PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION PROJECT NO.: 9539

<b>5</b> [			-	T	T	1	1	1	T -	T	Ī	<u> </u>	T		T	T	Ī	T	7
ECCATION: SAN DIEGO COONIT, CA	Remarks																		
NEC .NO.	Date	Dalas																,	
5		P/F																	
l	RS S	Date Tested																	
	REPAIRS	Date Repaired																	
		3																	
		Cumm. Feet																	
		Sq. Pt.						-											Notes:
	AREA	Width						-										-	
		Length 1 Length 2																	
	) 10 10 10 10 10 10 10 10 10 10 10 10 10	Number																	
200	Ninber																		
/ ** -	(Work Area)													-					
7	Number																		
t	Monitor															·			Ľ
40	Date										-								Manufacturer:

Manufacturer: Type:

### ACCEPTANCE OF SOIL SUBGRADE FOR THE SUPPORT OF GEOSYNTHETIC LINER (FML)

PROJECT NAME		Y CANYON LANDFILL TE LINER SYSTEM CC	NSTRUCTION	I
LINER CONTRA AREA APPROVE			· · · · · · · · · · · · · · · · · · ·	
•		· .		
the soil subgrade for shall be responsible project specification	r the support of the ge for maintaining its in as from this date to co	entative of the LINER Co cosynthetic liner in the afortegrity and suitability, in mpletion of the installations or character of the subs	orementioned ar accordance with on in this area.	ea. In the
NAME (PRINT)	SIGNATURE	TITLE	DATE	
				,
ACKNOWLEDGEI	D BY QA MONITOR			
NAME (PRINT)	SIGNATURE	COMPANY/TITLE	DATE	

### **B-4A**

# GCL PANEL PLACEMENT LOG SUMMARY

GeoLogic Associates
Geologists, Hydrogeologists and Engineers

PROJECT NO.: 9539

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

LOCATION: SAN DIEGO COUNTY, CA

Remarks												
Date	Covered											
	P/F											
RS	Date Tested											
REPAIRS	Y/N Date Repaired			,								
	Cumm. Feet											
	Sq. Ft.											
8	ķ											
AREA	Width											
	ngth 2											
	Length 1 Length 2											
	Leng	····										
Pot Pot Story	Number											
Roll												
		Arramo, M. V.								-		
(Work Area)	2 2											
Panel												
Αο Parito												
			-									
Date												

Type:

### **B-4B**

# GEOCOMPOSITE PANEL PLACEMENT LOG SUMMARY

GeoLogic Associates
Geologists. Hydrogeologists and Engineers

LOCATION: SAN DIEGO COUNTY, CA Date Covered P/F Date Tested PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION Y/N Date Repaired Cumm. Feet Sφ. F. Width Lot/ Batch Number Length 1 Length 2 Location Roll (Work Area) Number QA Panel Monitor Number PROJECT NO.: 9539

Manufacturer: Type:

Checked By:

Notes:



### B-5 FML PANEL PLACEMENT LOG

PROJECT: NO.: 9539 PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION LOCATION: SAN DIEGO COUNTY, CA CAP REPAIRED TESTED CHK'D BY: PATCH REPAIRED TESTED EXTRUDATE REPAIRED TESTED DATE: TIME: QA MONITOR: AMB: **REMARKS** PANEL #

### B-6

### FML SEAM TRIAL WELDS

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

LOCATION: SAN DIEGO COUNTY, CA

LOCATION: SAN DIEGO COUNTY,		Remarks												•		
LOCA		s QA Monitor					·									
UCTION	ults	Strength Mills (lbs/in)														
CONSTR	Test Results	Shear														
SYSTEM										-						
LINER		Preheat Peel FTB														
PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION	ature	Extrudate Pr											-			
ANDFILL,	Temperature	Wedge														
ANYON L		Ambient	,							-	·					
CORY CA	Time	(AM/PM)														
JECT: GRE	Technician			,												
PRO	Welder	Number														
PROJECT NO.: 9539	Date	Completed														
JECT NG	Sample	Number (Daily)												,		
PRO					,			 	 -							



## FML SEAMING LOG SUMMARY

LOCATION: SAN DIEGO COUNTY, CA Sample P/F Date Date
Number Repaired Tested Tested Sets PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION Yes/No Date Repaired St. Probe/ VI. Deg. F Deg. F Sheet Amb m.p.h. Time STATUS: Seam Length PROJECT NO.: 9539 Date Seamed Seam

GeoLogic Associates
Geologists, Hydrogeologists and Engineers

VT -Vaccum Test ST -Spark Test AP -Air Pressure Test VI -Visual Inspection

I -In Progress P -Pass F -Fail A -As built In

Seam Length:

Grand Total:\_

Total previous page(s) This page\_

### B-8

## FML DESTRUCTIVE TEST SUMMARY

Geologists, Hydrogeologists and Engineers PROJECT NO.: 9539

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

LOCATION: SAN DIEGO COUNTY, CA

Remarks														
7			,											
- 1	Adhesion (Ibs./inch)													
	FTB/ (FTB+Peel)													
\$	-												-	
Bonded Sedm Strength	Strength (lbs./inch)			·	-				•					
Bonded Sec	E						-							
Temperature	(Deg. F)													
E Dec														
E E														
Nimber							-							
Segment				-										
Negm Negm	(wedge/ extrusion)													
N del														

FTB - Film Tear Bond

### FML SEAMING LOG SUMMARY **B-0**

GeoLogic Associates
Geologists, Hydrogeologists and Engineers

PROJECT NO.: 9539

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

LOCATION: SAN DIEGO COUNTY, CA

Seam Date Seam Date Seam Between Temperature Non-Destructive Type Seamed Speed Sheet Amb Type Date Type Seamed Speed Sheet Amb Type Date P/F Y/N Date P/F Sample P/F Date Date Test Repaired Test Repa	8			
Dote Seamed Length Equipment Tech Time Wind Temperature Kon-Destructive Tests Repoirs Describe Samp Seamed Speed Sheet Amb Type Date P/F Y/N Date Date P/F Sample P/F Sample P/F Date Init. As bit. Number Temp.	Stortus	I/P/F/A		
Dote Seamed Length Equipment Tech Time Wind Temperature Non-Destructive Tests Repairs  Seamed Length Cest Amb Type* Date P/F Y/N Date Date P/F Sample Number  Init. As bit. Number Temp.  am/pm m.p.h. Deg. F Deg. F	*	Testsed Date		
Dote Seamed Length Equipment Tech Time Wind Temperature Non-Destructive Tests Repairs  Seamed Length Cest Amb Type* Date P/F Y/N Date Date P/F Sample Number  Init. As bit. Number Temp.  am/pm m.p.h. Deg. F Deg. F	uctive Sam	Date Repoired		
Date     Seamed     Equipment     Tech     Time     Wind     Temperature     Non-Destructive Tests     Re       Seamed     Spead     Sheet     Amb     Type*     Date     P/F     Y/N     Date       Init.     As bit.     Number     Temp.     am/pm     m.p.h.     Deg. F     Deg. F     Deg. F     Repaired		P/F		
Date     Seamed     Equipment     Tech     Time     Wind     Temperature     Non-Destructive Tests     Re       Seamed     Spead     Sheet     Amb     Type*     Date     P/F     Y/N     Date       Init.     As bit.     Number     Temp.     am/pm     m.p.h.     Deg. F     Deg. F     Deg. F     Repaired		Sample		
Date     Seamed     Equipment     Tech     Time     Wind     Temperature     Non-Destructive Tests     Re       Seamed     Spead     Sheet     Amb     Type*     Date     P/F     Y/N     Date       Init.     As bit.     Number     Temp.     am/pm     m.p.h.     Deg. F     Deg. F     Deg. F     Repaired		7		
Date     Seamed     Equipment     Tech     Time     Wind     Temperature     Non-Destructive Tests     Re       Seamed     Spead     Sheet     Amb     Type*     Date     P/F     Y/N     Date       Init.     As bit.     Number     Temp.     am/pm     m.p.h.     Deg. F     Deg. F     Deg. F     Repaired	ojus	Pate Sete		
Seamed Length Equipment Tech Time Wind Seamed Speed I Length Number Temp.	Rep	Date Repaired		
Seamed Length Equipment Tech Time Wind Seamed Speed I Length Number Temp.		ξ.		
Seamed Length Equipment Tech Time Wind Seamed Speed I Length Number Temp.	Teats	P/F		
Seamed Length Equipment Tech Time Wind Seamed Speed I Length Number Temp.	estructive	Pd .		
Seamed Length Equipment Tech Time Wind Seamed Speed I Length Number Temp.	Non-D	ed.		
Seamed Length Equipment Tech Time Wind Seamed Speed I Length Number Temp.	roture	æ	Deg. F	
Seamed Length Equipment Tech Time Seamed Length Number Temp.	Tempe	Sheet	Deg. F	
Seamed Length Teurphornt Tech Seamed Length Length Number Temp.	P.	<b>8</b>		
Seamed Length Feet Init. As bit. Number Temp.	Ē	увать в	md/mp	,
Seamed Seamed	-Fe			
Seamed Seamed	<b>Jent</b>		Temp.	
Seamed Seamed	Equipn	-	Number	
Seamed Seamed		ee d	<b>A</b> DE	
Seam Seam Date Number Type Seamed			差	
Seam Seam Number Type	Date	Segmed		
Number	Sedm	<u>\$</u>		
	Sedin	Neder		

	Ŀ	3			
	Stortue	1/P/F/A			
	•	Dote Tested			
	Destructive Sample	Sheet Amb Type Date P/F Y/N Date Date P/F Sample P/F Date Repoired Tested Number Repoired	•	-	
	Dest	P/F			
-		Sample			
		P/F			
	in in	Tests bets			
	Repoirs	Date Repaired			ary and a second
		ξ.			
	acte	P/F			
	Temperature Non-Destructive Tests	eg d			
	Non-De	Type			
	eroture	<b>Amb</b>	Deg. F		
	Temp	Sheet	am/pm m.p.h. Deg. F Deg. F		
	Mind		m.p.h.		
	Time	Seamed	md/mo		
	Tech				
	Equipment		Temp		
	Equip		Init. As bit. Number		
	mp e	feet	As Dit		
			불		
	Seam Seam Date	Seamed			
	Seam	<b>8</b>			
	Sedm	Number			
			_		

Monitor

_			_	
8	Monftor			
Stotus	1/P/F/A			
	Tested Tested			
Destructive Sample	Sheet Amb Type* Date P/F Y/N Date Date P/F Sample P/F Date Repaired Tested Number Repaired			
Petr	7			
	Sample F			
	P/F			
Ē	Date Tested			
Repairs	Date Repaired			
	X.			
\$	P/F			
structive T	Date			
Non-De	1ype			
roture	φwγ	Deg. F		
Temperature Non-Destructive Tests	Sheet	m.p.h. Deg. F Deg. F		
Wind	<b>D</b>	m.p.h.		
Time		am/pm		
Tech				
Jent		Temp.		
Equipment		Init. As bit. Number		
E	L <b>ength</b> feet	<b>\$</b> ⊅t		
8	<b>5</b> .º	差		
Date	Seamed			
Seam Seam Date	<u>\$</u>			
Seam	Number			

<b>\</b>			
<ul><li>* - Note what type of test was used:</li></ul>	STATUS:	SEAM TYPE:	Checked B
VT —Vaccum Test ST —Spark Test AP —Air Pressure Test	l -In Progress P -Pass F -Fail A -As built In	EW —Extrusion Weld Seam WW —Wedge Weld Seam	

Seam Length (this page): Total (previous pages):

Grand Total:

VT -Vaccum Test ST-Spark Test AP-Air Pressure Test

### B-10 GEOTEXTILE RECEIVED

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION PROJECT NO.: 9539

LOCATION: SAN DIEGO COUNTY, CA

CQA Test Result COA Test Received CQA Sample Sent to Lab CQC Doc. Received Notes: Cumulative Sq. Ft. Rcvd. Area sq. ft. AREA Width feet Status: Length Lot/Batch Number Roll Number OA Monitor Manufacturer: Date Received

GeoLogic Associates
Geologists, Hydrogeologists and Engineers

l – In progress P – Pass F – Fail

Type: CQC - Construction Quality Control CQA - Construction Quality Assurance

### B-11

## GEOTEXTILE CONFORMANCE TEST

GeoLogic Associates
Geologists, Hydrogeologists and Engineers

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION PROJECT NO.: 9539

LOCATION: SAN DIEGO COUNTY, CA

				3			<del></del>	 	<del></del>			,	 	 ·		_
Remarks			aanaankaanaankaanaankaanaanaanaanaanaana										•			
Status I/P/F			***************************************								-					
Material Represented	Sq. ft.		annunununun .													
Roll	feet		mununun													
Roll Length	feet		annananana													
			<i>*************************************</i>													
		##:	<del></del>	<del>\</del>						·						
		##	<del>~~~~~</del>				·									Notes:
		444	<i>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</i>													
-11										-						 Status:
Type																55
Lot Number (Railcar)			Acceptable Limits		*											
Roll			imits													
Date		ification	otable L			Communication of the first of t										50
Test Number		Speci	Accep													Manufacturer:

I – In progress P – Pass F – Fail

### B-12

## GEOTEXTILE PLACEMENT LOG

GeoLogic Associates
Geologists, Hydrogeologists and Engineers

PROJECT NO.: 9539

PROJECT: GREGORY CANYON LANDFILL, COMPOSITE LINER SYSTEM CONSTRUCTION

LOCATION: SAN DIEGO COUNTY, CA

Municipal (Trans Act) Multiple Ingith 1 Langth 2 Width Sq. Ft. Cultum. Yea/Ne Repaired Treted	Maring   Marings   Marin	Date	A in	Panel	Location (Work Area)	Roll				AREA				REPAIRS	Date	Remarks
					(De V VIDIL)		Number	Length 1	Length 2	Width	Sq. Ft.	İ	Yes/No	Date Repaired	Covered	
	Nodes:															
	Modes:															
	Modes:															
	Notes:															
													<i>XIIIIII</i>			
	Notes:												MIIIII			
	Notes:															
	Notes:															
	Notes:								-							
	Notes:															
	Notes:															
	Notes:										·					
	Notes:		·										<i>Municipal</i>			
	Notes:															
	Notes:				-				-							
									<del></del>				Munio.			

Type: